ENGINEERING

Deciding What to Read to Keep Informed

Insulation for Ultra-Low Temperatures

Current Evolution of the Grand Prix Car

Mixing Gases and Gibbs' Paradox

Telemetering for Bluebird

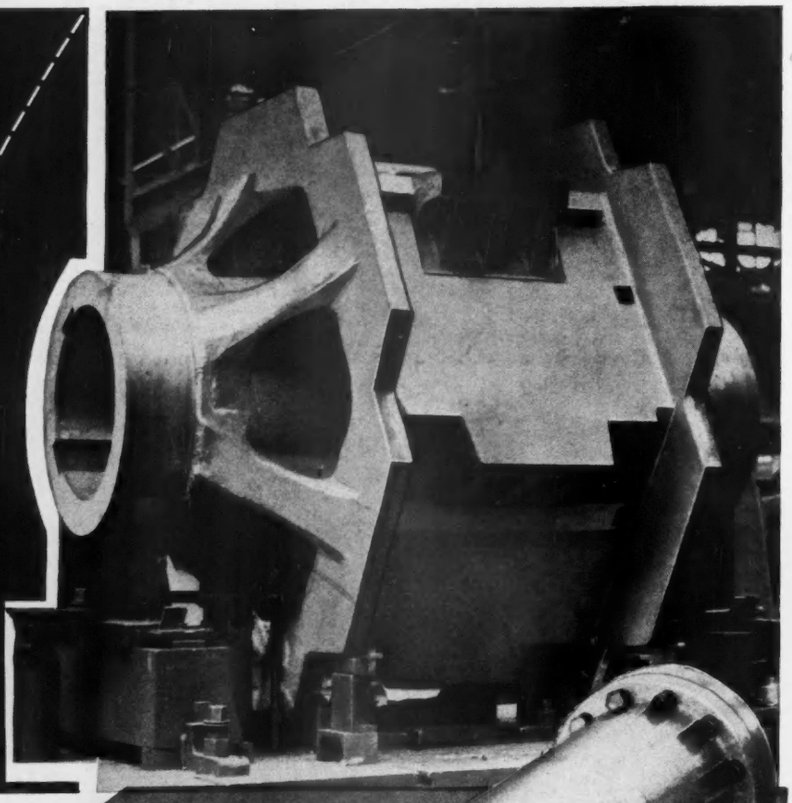
Trends in Commercial Vehicle Design

Book Review
Sir Sydney Camm on the Designer of the Focke-Wulf 190

PRICE
2/-

Crankcase Fixture

THINK OF STEEL FIRST



Top tumbler for tin dredging. Weight 17½ tons.

ality steel castings
any applications
offer certain econ-
advantages over
production
ods. Before final-
your requirements
INK OF CASTINGS FIRST
consult Hadfields
name celebrated for
eels in CARBON—LOW
LOY—STAINLESS—
NGANESE—WEAR
ESISTING—HEAT
ESISTING STEELS.

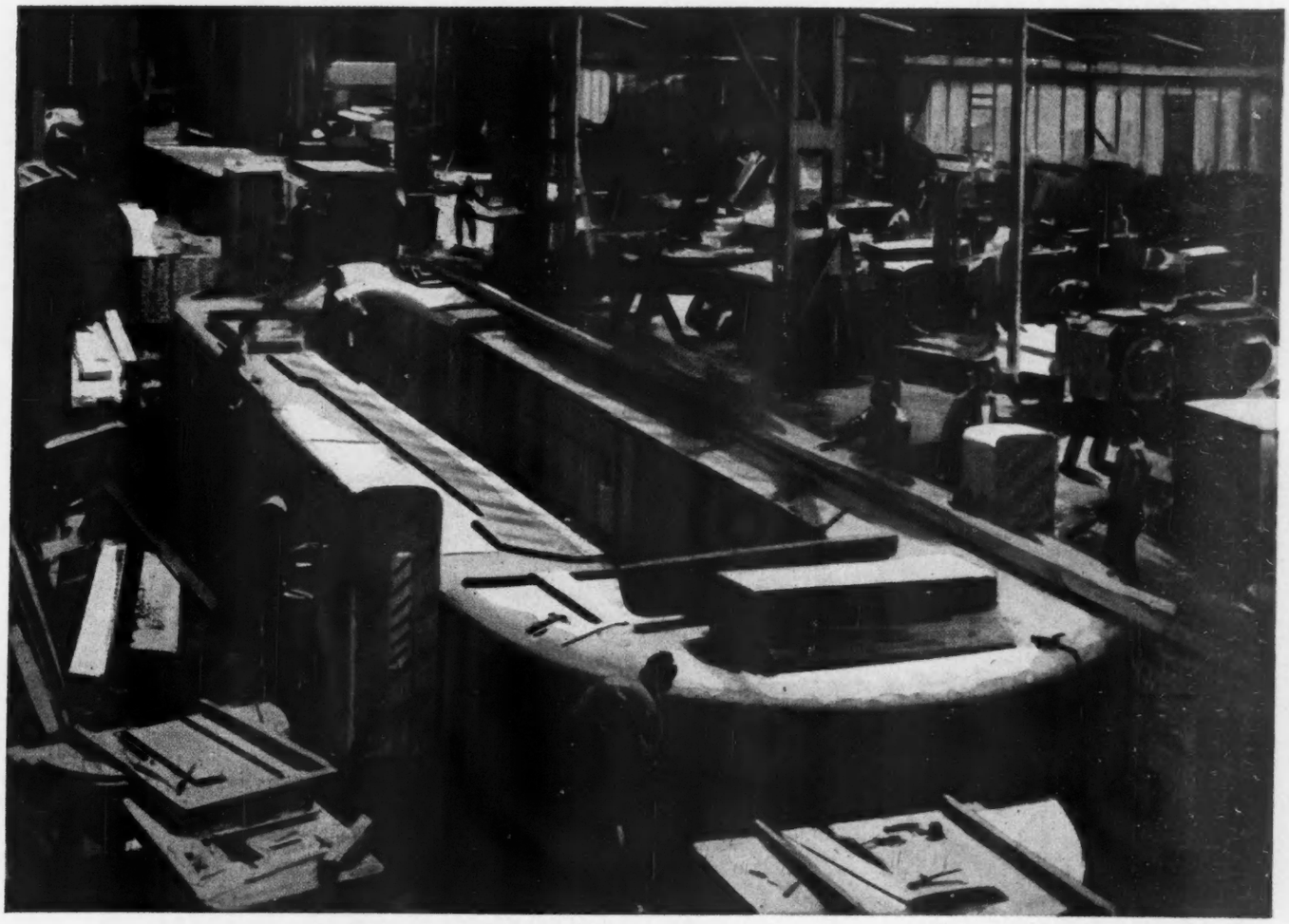
Tilting cylinder assembly. Weight 18 tons.

HADFIELDS
SHEFFIELD

HADFIELDS LTD. · EAST HECLA WORKS · SHEFFIELD · ENGLAND.

Palette on Production

No. 1 in a series of original paintings specially commissioned from Robert Johnston, R.I., S.M.A., illustrating the productive resources for metalworks plant of Davy-United's Darnall Works. The scene shows the making of a pattern for a roll housing for a 12 foot wide hot plate mill for aluminium. When cast the housing weighed 163 tons while the pattern itself took nearly three tons of timber.



DAVY-UNITED

Issued by the Machinery Division of Davy and United Engineering Company Limited

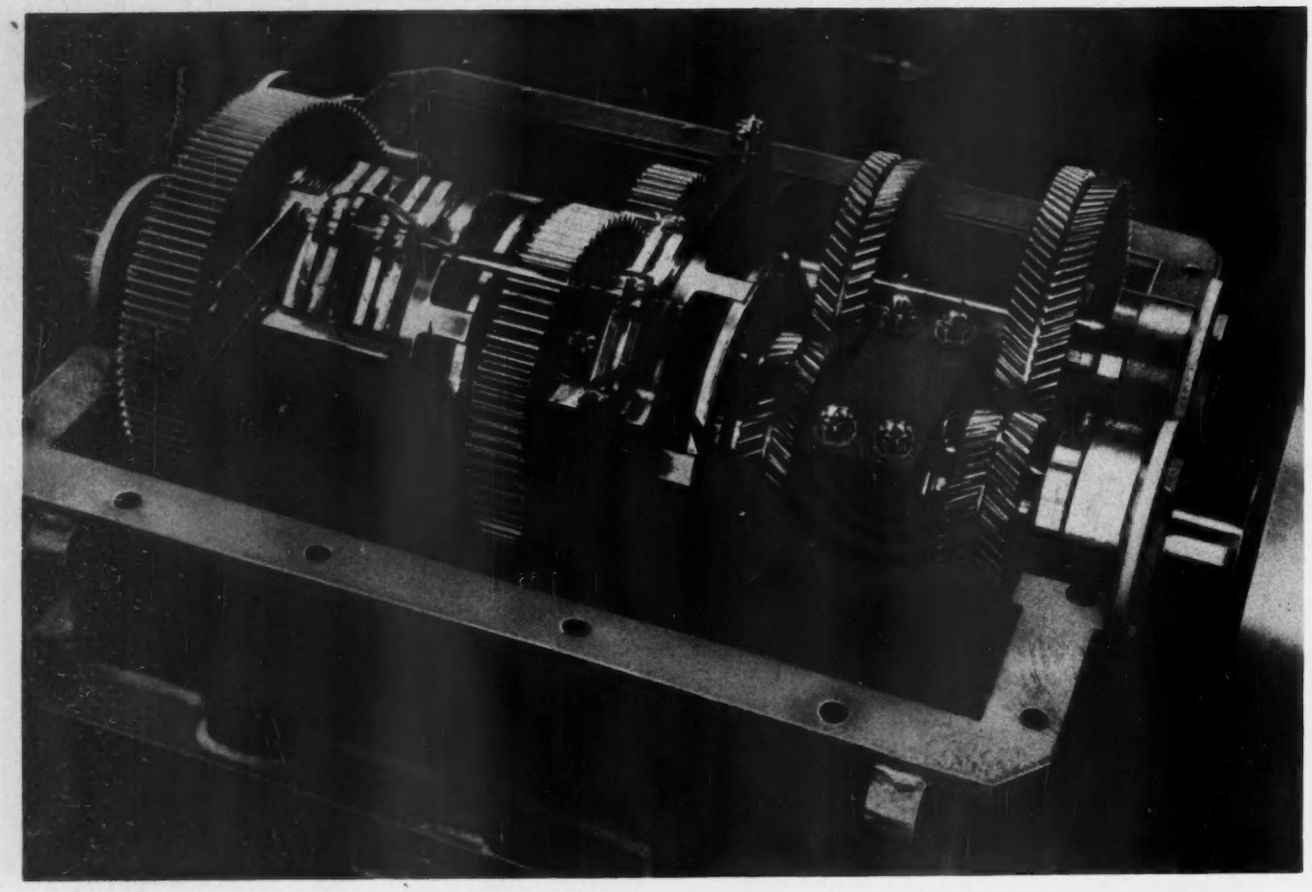
ROLLING MILLS

FORGING PRESSES

METALWORKS PLANT

294/DUC

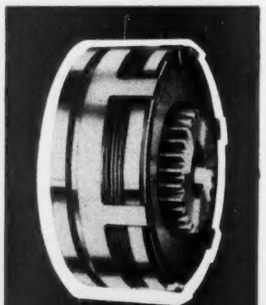
A



push-button power

with Crofts 'Autojust' Magnetic Clutches. Three 'Autojusts' in this gear box provide instantaneous gear-changing at the operator's slightest touch.

Designed to be used as either clutch or brake the 'Autojust' operates on 24 volts DC in a range of sizes up to 40 h.p. at 100 r.p.m. And you never need to adjust an 'Autojust'!



Send NOW for Publication 604

Crofts
REGD TRADE MARK

CROFTS (ENGINEERS) LIMITED

POWER TRANSMISSION ENGINEERS

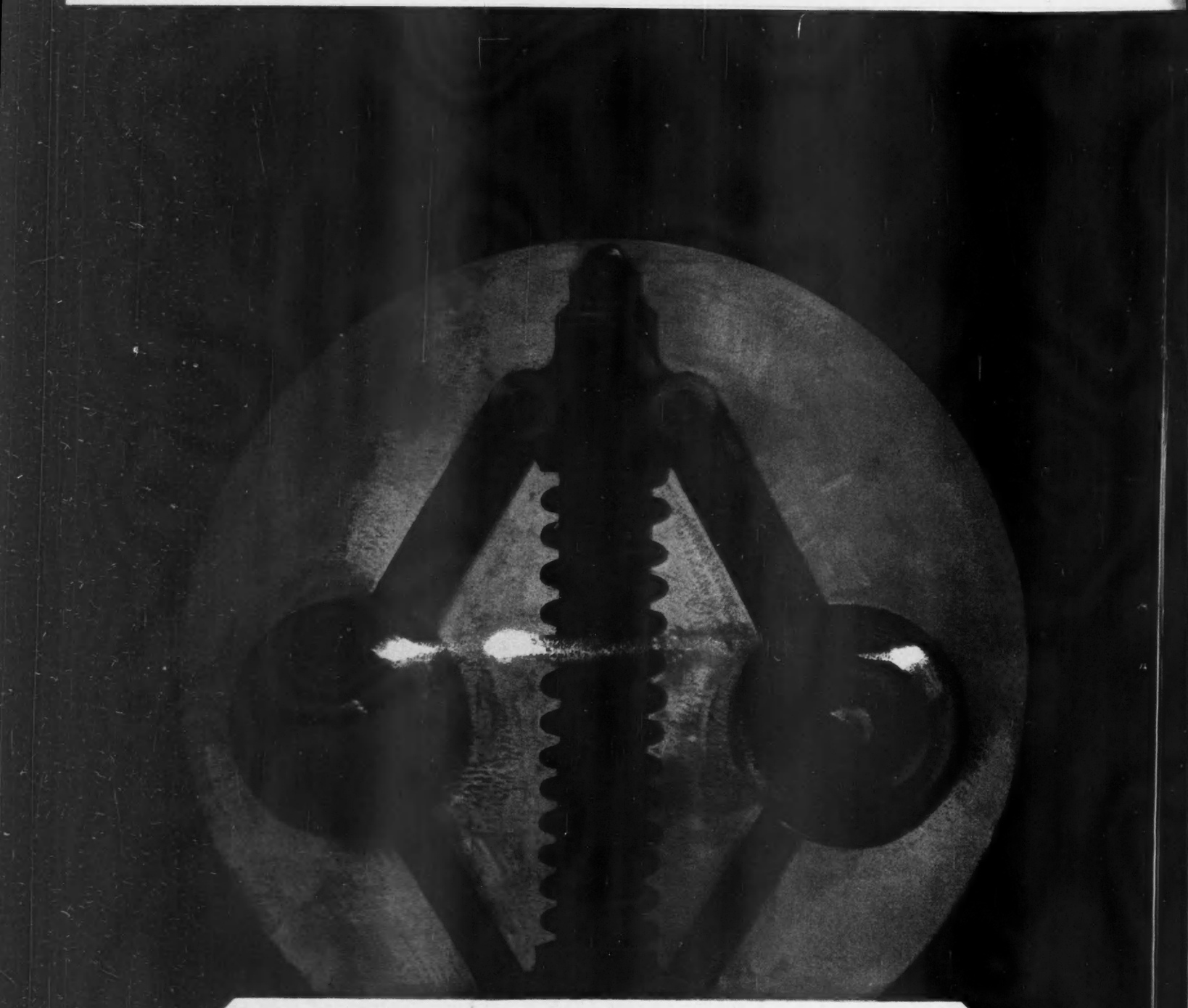
THORNBURY BRADFORD 3 YORKSHIRE *Telephone: 65251 (20 lines)*

Telegrams: "Crofters Bradford Telex" Telex 51186

BRANCHES AT: Belfast Birmingham Bristol Cardiff Dublin Glasgow Ipswich Leeds Liverpool London Manchester Newcastle Northampton Nottingham Sheffield Stoke-on-Trent

Subsidiary Companies in Canada, South Africa, U.S.A. *World-wide Representation*

HEAVY CAPITAL EQUIPMENT
Fabricating
Machining
Write for further details
ASHMORE, BENSON, PEASE & COMPANY LIMITED
STOCKTON-ON-TEES AND LONDON
DAVY-ASHMORE GROUP
456 PARIS MONTREAL MELBOURNE JOHANNESBURG



ACCURATE SPEED CONTROL

The static friction which hampers the sensitivity of so many types of governor is eliminated in the Iso-Speedic governor by the use of flybobs consisting of hardened steel balls running on ground steel tracks.

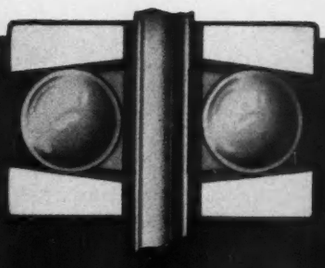
As a result, Iso-Speedic governors can be supplied which give control within 0.3 per cent and are used on generators for radar and television.

Other Iso-Speedic governors are available where a lower degree of accuracy is sufficient. Iso-Speedic governors are used on diesel engines and petrol engines and are available for other speed control applications.

The services of our engineers are at your disposal.

THE ISO-SPEEDIC COMPANY LIMITED,
CHARLES STREET, WARWICK

Iso-Speedic



16 September 1960

Vol. 190 No. 4926

Founded in 1866

ENGINEERING

PUBLISHED EVERY FRIDAY

36 Bedford Street London WC2 England Telephone: Temple Bar 3663

Contents

370 Metals and Materials

Insulating for Ultra Low Temperatures
By J. W. Dawson

374 New Plant and Equipment

Pinhole Detector, Nail Extractor, Document Holder, Dump Trucks, Tool Grinder, Utility Head, Motor Controller, Impact Tester, Spot Welder, Sine Centres, Ultra Violet Lamp, Connectors, Steam Trap, Flame Cutter, Standby Lamp, Automatic Press, Surface Thermometer

380 Construction

Climbing Cranes on Suspension Bridge Towers, Jetty for Launches at Milford Haven, Reducing Evaporation from Service Reservoirs, Acoustic No-Fines Concrete, Machine Shop Foundations in Four Days, Factory Building at Speed, Lightweight Structural Panel, Nylon Safety Belt Shows Red for Danger, Precast Units in Super-Sulphate Cements, Concrete Piles in Sea Water

386 Production

Automatic Test on Mass Produced Switch

Machine Tool Transformation, Experimental Forge Furnace

388 Operation and Maintenance

Vertical Boilers Explode Due to Unexplained Cracks, The Biggest Pressure Test So Far, Air Flow in Fruit Cold Stores, Stopping Jets with Nylon Nets, Non-Scheduled Flights Cut at London Airport, Hand Lubrication of High-Speed Testing Track, Six Litres of Ultrasonic Cleaning

394 Design

Telemetering for Bluebird
By A. D. Runnals

Farm Tractor with Two Types of Implement Control

397 Research and Development

Britain's Missile Tested at Spadeadam

Mixing Gases and Gibbs' Paradox
By P. Chambadal

369 Impact

377 Human Element

385 Companies

393 Marketing

Special Articles

379 Deciding What to Read to Keep Informed
By C. W. Hanson

382 New Lorries Easier to Drive—and Safer

383 Atomic Review

Compact Reactors

396 Automobile Review

Current Evolution of the Grand Prix Car
By Brian Lister

400 At Home

Well-Water on Tap

372 Plain Words

By Capricorn

372 Letters to the Editor

Space Engineering
L. J. Carter
Friction Welding
E. J. French
Who Pays Development Costs?
R. A. Hunter
A Dirty Job
Raoul Sablyak
Noise Annoyance
Professor E. J. Richards

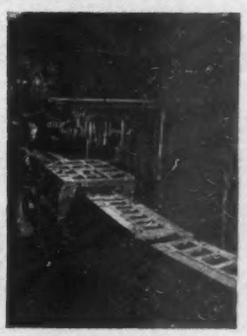
373 Events in Advance

390 Publications

On the Shelf
By Frank H. Smith

Industrial Packaging
Commercial Road Vehicles
Design for Flight: The Kurt Tank Story
High Productivity in Heavy Engineering

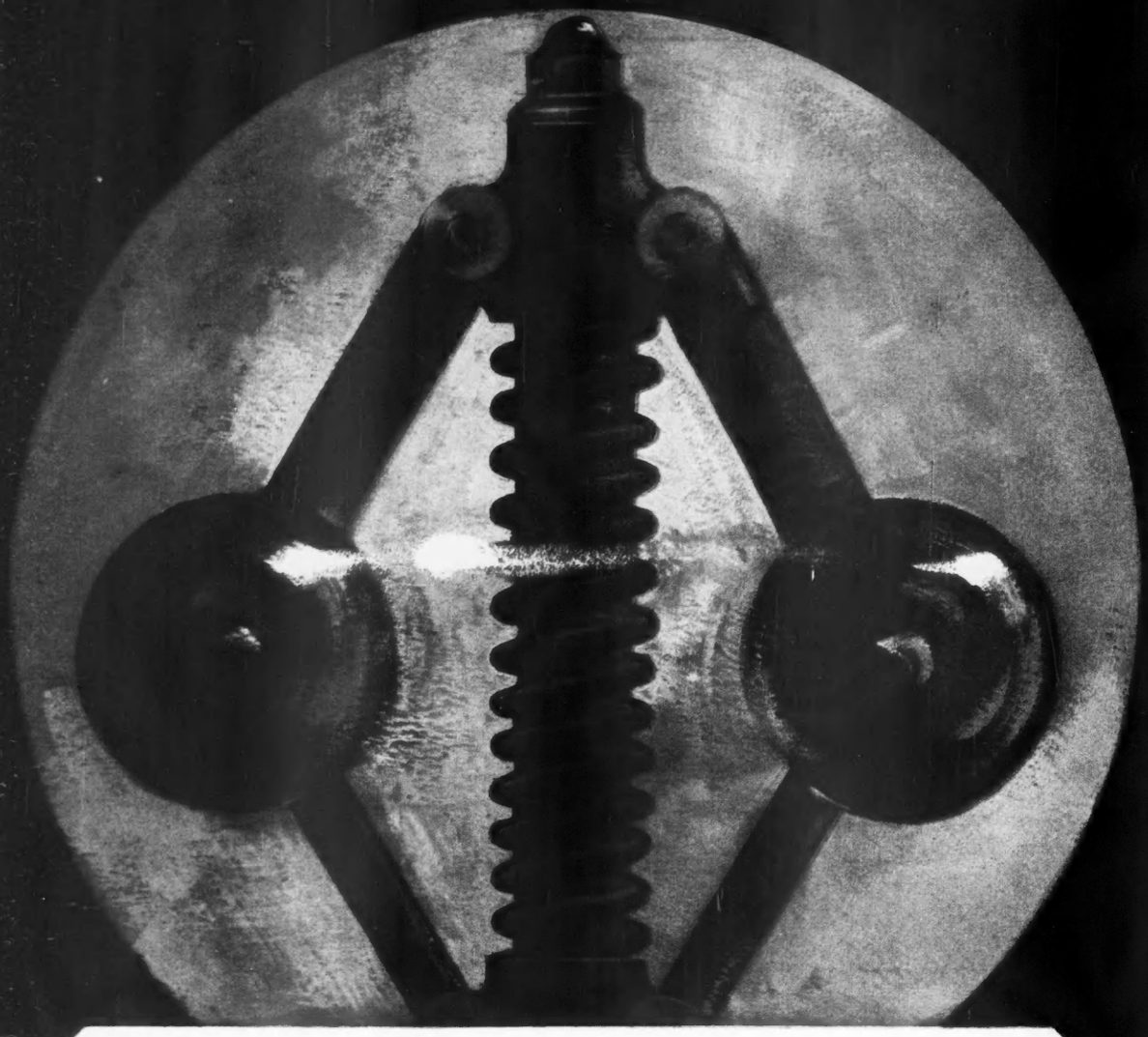
New Books and Trade Publications



Cover Picture

A six cylinder crankcase is shown being loaded into a fixture of a 34 spindle automatic cycle machine for boring and drilling the holes in the door side. An air-operated fixture is being used. (*Nurnberg photograph for* ENGINEERING)

Subscription Rates: Editorial page 400 Index to Advertisements: Overleaf Engineering Appointments Section: Faces page 384



ACCURATE SPEED CONTROL

The static friction which hampers the sensitivity of so many types of governor is eliminated in the Iso-Speedic governor by the use of flybobs consisting of hardened steel balls running on ground steel tracks.

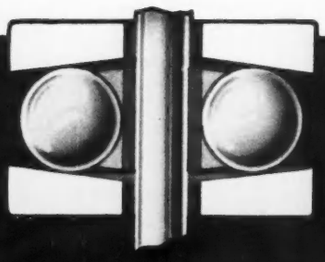
As a result, Iso-Speedic governors can be supplied which give control within 0.3 per cent and are used on generators for radar and television.

Other Iso-Speedic governors are available where a lower degree of accuracy is sufficient. Iso-Speedic governors are used on diesel engines and petrol engines and are available for other speed control applications.

The services of our engineers are at your disposal.

THE ISO-SPEEDIC COMPANY LIMITED,
CHARLES STREET, WARWICK

Iso-Speedic



16 September 1960

Vol. 190 No. 4926

Founded in 1866

ENGINEERING

PUBLISHED EVERY FRIDAY

36 Bedford Street London WC2 England Telephone: Temple Bar 3663

Contents

370 Metals and Materials

Insulating for Ultra Low Temperatures
By J. W. Dawson

374 New Plant and Equipment

Pinhole Detector, Nail Extractor, Document Holder, Dump Trucks, Tool Grinder, Utility Head, Motor Controller, Impact Tester, Spot Welder, Sine Centres, Ultra Violet Lamp, Connectors, Steam Trap, Flame Cutter, Standby Lamp, Automatic Press, Surface Thermometer

380 Construction

Climbing Cranes on Suspension Bridge Towers, Jetty for Launches at Milford Haven, Reducing Evaporation from Service Reservoirs, Acoustic No-Fines Concrete, Machine Shop Foundations in Four Days, Factory Building at Speed, Lightweight Structural Panel, Nylon Safety Belt Shows Red for Danger, Precast Units in Super-Sulphate Cements, Concrete Piles in Sea Water

386 Production

Automatic Test on Mass Produced Switch

Machine Tool Transformation, Experimental Forge Furnace

388 Operation and Maintenance

Vertical Boilers Explode Due to Unexplained Cracks, The Biggest Pressure Test So Far, Air Flow in Fruit Cold Stores, Stopping Jets with Nylon Nets, Non-Scheduled Flights Cut at London Airport, Hand Lubrication of High-Speed Testing Track, Six Litres of Ultrasonic Cleaning

394 Design

Telemetering for Bluebird
By A. D. Runnals

Farm Tractor with Two Types of Implement Control

397 Research and Development

Britain's Missile Tested at Spadeadam

Mixing Gases and Gibbs' Paradox
By P. Chambadal

369 Impact

377 Human Element

385 Companies

393 Marketing

Special Articles

379 Deciding What to Read to Keep Informed
By C. W. Hanson

382 New Lorries Easier to Drive—and Safer

383 Atomic Review
Compact Reactors

396 Automobile Review
Current Evolution of the Grand Prix Car
By Brian Lister

400 At Home
Well-Water on Tap

372 Plain Words
By Capricorn

372 Letters to the Editor

Space Engineering
L. J. Carter
Friction Welding
E. J. French
Who Pays Development Costs?
R. A. Hunter
A Dirty Job
Raoul Sablyak
Noise Annoyance
Professor E. J. Richards

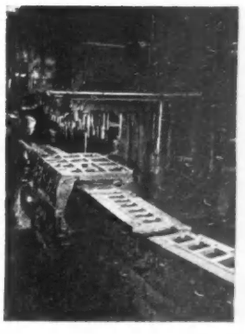
373 Events in Advance

390 Publications

On the Shelf
By Frank H. Smith

Industrial Packaging
Commercial Road Vehicles
Design for Flight: The Kurt Tank Story
High Productivity in Heavy Engineering

New Books and Trade Publications



Cover Picture

A six cylinder crankcase is shown being loaded into a fixture of a 34 spindle automatic cycle machine for boring and drilling the holes in the door side. An air-operated fixture is being used. (*Nurnberg photograph for* ENGINEERING)

Subscription Rates: Editorial page 400

Index to Advertisements: Overleaf

Engineering Appointments Section: Faces page 384

Advertisers in 'Engineering' this week

	PAGE
AFSA, Ltd.	6
Acru Electric Tool Mfg. Co., Ltd.	44
Armstrong Patents Co., Ltd.	63
Armstrong Stevens & Son, Ltd.	79
Arrol, Sir Wm., & Co., Ltd.	40
Ashmore, Benson, Pease & Co., Ltd. *Wrapper* V	
Associated Electrical Industries, Ltd. Heavy Plant Division	29
Transformer Division	37
Atlas Copco AB. (Sweden)	38 & 39
Austin, J., & Sons (Dewsbury), Ltd.	31
Automotive Products Co. Ltd.	46
Babcock & Wilcox, Ltd.	17
Barns, W. & Son (Holloway), Ltd.	9
Belmos Co., Ltd.	18
Booth, Joseph, & Bros.	74
British Industrial Engineering Co. (Staffs), Ltd.	51
British Steam Specialties Ltd.	11
Broom & Wade, Ltd.	35
Brotherhood, P., Ltd.	73
Brown, David, Corpn. (Sales), Ltd.	7
Brown, Donald (Brownall) Ltd.	22
Budenberg Gauge Co. Ltd.	50
Burgess Products Co., Ltd.	30
Clark, G., & Sons (Hull) Ltd.	19
Clyde Crane & Booth, Ltd.	74
Clyde Crane & Engineering Co.	74
Colt Ventilation, Ltd.	25
Crane, Ltd.	28
Craven Bros. Crane Division Ltd.	61
Crockatt, W., & Sons, Ltd.	4
Crofts (Engineers) Ltd. *Wrapper* IV	
Davy & United Eng'g. Co., Ltd. *Wrapper* III	
Davy - Ashmore Group *Wrapper* V	
Day, James (Machinery) Ltd	30
Dee Oil Co., Ltd.	53
Douglas, Lawson & Co., Ltd.	6
Dowty Seals, Ltd.	65
Drummond-Asquith Ltd.	32
Drysdale & Co., Ltd.	12
Dyson, R. A., & Co., Ltd.	42
E.N.V. Engineering Co., Ltd.	62
Edwards, F. J., Ltd.	42
Empire Rubber Company	42
"Engineering" Quickbinde	79
"Engineering" Reprints	4, 5, & 42
English Steel Forge & Eng'g Corporation, Ltd.	64
Eutectic Welding Alloys Co., Ltd.	10
Falk, Stadelmann & Co., Ltd.	59
Fearnehough, W., Ltd.	42
Ferranti, Ltd.	23
Fleming & Ferguson, Ltd.	11
Fraser, John & Son Ltd.	75
Fullerton, Hodgart & Barclay, Ltd.	76
General Descaling Co., Ltd.	33
Govan Shafting & Engineering Co.	44
Greening, N., & Sons, Ltd.	11
Greenwood's Standard Gear Cutting Co., Ltd.	50
Guest, Keen & Nettlefolds (Midlands), Ltd.	78
Gwynnes Pumps, Ltd.	52
Hadfields, Ltd. *Wrapper* II	
Hall, J. & E., Ltd.	41
Harvey, G. A., & Co. (London) Ltd. *Wrapper* VII	
Haskins	28
Head Wrightson Teesdale Ltd.	83
Heap, J., & Co., Ltd.	87
Hick Hargreaves & Co., Ltd.	67
Hilmor, Ltd.	87
Hoffmann Mfg. Co., Ltd.	22
Holroyd, J., & Co., Ltd.	66
Horstmann Gear Co. Ltd.	13
Hudswell, Clarke & Co., Ltd.	5
Hydraulics & Pneumatics Ltd.	85
Ilford, Ltd.	72
International Combustion, Products Ltd.	24
Iso-Speedic Co. Ltd. *Wrapper* VI	
Joy-Sullivan, Ltd.	14
Kidde, Walter, Co., Ltd.	75
King, G. W., Ltd.	80
Klinger, R., Ltd.,	68 & 69
Lafarge Aluminous Cement Co., Ltd.	49
Lanarkshire Bolt, Ltd.	53
Leeds Eng'g. & Hydraulic Co., Ltd.	46
LimiTorque Valve Controls, Ltd.	82
Low, A., & Sons Ltd.	81
Mather & Platt, Ltd.	85
Mechans Ltd.	55
Michell Bearings, Ltd.	11
Mobil Oil Co., Ltd.	43
Mond Nickel Co., Ltd.	54
Morris, H., Ltd.	61
Newalls Insulation Co., Ltd.	76
Newton Chambers & Co., Ltd.	26 & 27
Nitralloy, Ltd.	82
Norris Bros., Ltd.	5
Odoni Equipment, Ltd.	6
Osborn, S., & Co., Ltd.	70
Pegler & Louden, Ltd.	75
Peglers, Ltd.	20
Plant Engineers, Ltd.	21
Pool, J. & F., Ltd.	5
Power Auxiliaries, Ltd.	87
Power Petroleum Co., Ltd.	34
Power Plant Co., Ltd.	50
Ratcliffe, F. S. (Rochdale) Ltd.	82
Richards, Geo., & Co., Ltd.	8
Richardsons, Westgarth & Co. Ltd.	56
Saunders-Roe, Ltd.	60
Seagers, Ltd.	50
Service Electric Co., Ltd.	4
Simon Handling Engineers Ltd.	86
Smith, H. & Co. (Possil), Ltd.	84
Smiths Industrial Instruments, Ltd.	44
Spiro-Gills, Ltd.	45
Steele & Cowlishaw, Ltd.	4
Stein Atkinson Vickers Hydraulics, Ltd.	57
Stillite Products Ltd.	15
Stubs, Peter, Ltd.	2
Summers, John, & Sons, Ltd.	5
Sumo Pumps, Ltd.	75
Sutcliffe, R., Ltd.	36
Tangyes, Ltd.	86
Technoexport	58
Thompson, J., (Dudley) Ltd., *Wrapper* VIII	
Town, Fredk. & Sons, Ltd.	47
Transport Equipment (Thornycroft) Ltd.	53
Tufnol, Ltd.	77
Turner Bros. Asbestos Co., Ltd.	79
Vickers-Armstrongs (Engineers), Ltd.	16
Vokes Genspring Ltd.	71
Wakefield-Dick Industrial Oils, Ltd.	48
Warren-Morrison Ltd.	82
Welsh Metal Industries, Ltd.	88
Wigglesworth, Frank, & Co., Ltd.	31
Wilkinson Rubber Linatex, Ltd.	44
Wiseman, A., & Co., Ltd.	30

'Engineering' Appointments Section
Inside Editorial Section

Appleby - Frodingham Steel Co.	4
Babcock & Wilcox, Ltd.	3
Central Electricity Generating Board	1 & 3
Clive, Robert (Consultants), Ltd.	4
Fibreglass, Ltd.	3
General Electric Co., Ltd., Atomic Energy Div.	3
Glacier Metal Co., Ltd.	4
Humphreys & Glasgow, Ltd.	4
Machine Tool Industry Research Assn.	1
Nigeria, Northern Govmt. of	1
Pilkington Bros., Ltd.	4
Rylands Brothers (Australia) Proprietary Ltd.	1
Stewarts & Lloyds, Ltd.	4
Super Oil Seals and Gaskets, Ltd.	2
Taylor Woodrow Construction, Ltd.	4
U.K.A.E.A.	2

Classified: Trade & Technical

Ahmed, S. M., & Co., Ltd.	3
Edwards, F. J.	3
Pratchitt Bros., Ltd.	3
Research Engineers, Ltd.	3
Ward, T. W., Ltd.	3

A size for every job
from 1/64" to 1½" diameter in standard lengths of 78", 39" and 13"
All with the same consistent quality, accuracy and finish that has made
GENUINE STUBS
SILVER STEEL
The most famous brand in the world
Write for catalogue No 75, free on request.
PETER STUBS LIMITED · WARRINGTON · ENGLAND
Founded in 1773

Trade and Technical

EDUCATIONAL

ENGINEERING COURSES BY POST A.M.I.MECH.E., CITY & GUILDS, ETC., and many practical training courses in Mechanical, Motor and Electrical work. No books to buy.—Write for FREE Prospectus stating subject to I.C.S., INTEX-TEXT HOUSE, PARKGATE ROAD (DEPT. 420), LONDON, S.W.11. G 890

NATIONAL COLLEGE FOR HEATING, VENTILATING, REFRIGERATION AND FAN ENGINEERING
at
Borough Polytechnic,
Borough Road, London, S.E.1.
A course of Eight Lectures
on
TUBULAR HEAT TRANSFER EQUIPMENT
Monday evenings, beginning
24th October, 1960.
Other subjects to be offered in 1961 include:—
(i) Drying and the theory of mass and heat transfer.
(ii) Refrigeration heat and mass transfer.
(iii) Experimental techniques.
Application forms and further information from:
FREDK. J. PACKER,
Clerk to the Governors. C 977

CONSULTANTS & EXPERIMENTAL WORK

RE

PROTOTYPES

EXTREMELY ACCURATE PLATE CAMS

ELECTRONICALLY CONTROLLED CAM MILLING MACHINES

SPECIAL PURPOSE MACHINES

Research Engineers Ltd.,
CANONBURY, N.1.
CAN 4244/5/6
Telegrams: "Wilmaket, Nordo, London." G 878

TENDERS

THE OFFICE OF THE DIRECTOR GENERAL, INDIA STORE DEPARTMENT, GOVERNMENT BUILDING, BROMYARD AVENUE, ACTON, W.3, invites TENDERS for the following:—

(a) **HORIZONTAL TURRET LATHE,** Max. swing over bed 572 mm., max. swing over cross slide 317 mm. dia. of hole through spindle 108 mm.... ... 1 off.
(b) **HEAVY DUTY PLANO MILL** with milling heads, one each on uprights and two on cross slide—Sliding Table 365 mm. by 1219 mm. ... ... 1 off.
(c) **HIGH SPEED GUN BARREL BORING AND TREPANNING MACHINE** for barrels 18 in. O.D. and 30 ft. long. Full details of boring operations available.
(d) **SHELL LATHES FOR INTERNAL BLENDING.** Jobs 3 in. to 4 in. dia. and 18 in. long. Drawings available.

Specifications, etc., can be obtained from the CO-ORDINATION BRANCH, INDIA STORE DEPARTMENT, GOVERNMENT BUILDING, BROMYARD AVENUE, ACTON, W.3, at a cost of 10s. per tender enquiry and is not refundable. Tenders are to be returned to the above address by MONDAY, 24th OCTOBER, 1960.

Specimen copy of the above enquiries can be seen at Engineering Branch, I.S.D. under the following references:—
(a) 2001/60/SGH/ENG. 3.
(b) 2012/60/SGH/ENG. 3.
(c) 2017/60/SGH/ENG. 3.
(d) 2027/60/SGH/ENG. 3. C 946

FORTH ROAD BRIDGE

CONTRACT No. 5

(ROAD WORKS NORTH OF FIRTH OF FORTH)

TENDERS are invited from experienced Contractors for the execution of work comprising:—
(1) Approximately 3½ miles of dual-carriageway approach roads and 4 miles of connecting roads;
(2) 10 reinforced concrete bridges;
(3) 600 foot long reinforced concrete viaduct; and
(4) 1,000 foot long twin tunnels.

Copies of the Contract Documents and Drawings may be obtained from the Consulting Engineers, Messrs. Mott, Hay & Anderson, 14, Melville Street, Edinburgh, 3, on payment of a deposit of £30 by cheque made payable to the Forth Road Bridge Joint Board. The deposit will be repayable when a bona fide tender has been received and all drawings returned.

Tenders must be sent in sealed plain cover marked "Tender for the Forth Road Bridge Contract," and addressed to THE CLERK, FORTH ROAD BRIDGE JOINT BOARD, CITY CHAMBERS, EDINBURGH, 1, so as to be received there not later than 15th NOVEMBER, 1960.

The Joint Board do not bind themselves to accept the lowest or any Tender.

W. BORLAND,
CLERK TO THE FORTH ROAD BRIDGE JOINT BOARD. C 936

THE DIRECTOR GENERAL OF INDIA STORE DEPARTMENT, GOVERNMENT BUILDING, BROMYARD AVENUE, ACTON, LONDON, W.3, invites tenders for the supply of:—
20033/60/HSK/HAL.2
"AIR COMPRESSORS—VERTICAL, two stage, Double acting, 8 in. Stroke, 520 C.F.M. —2 Nos."

The tender forms with schedules and specifications which are returnable on THURSDAY, 27th OCTOBER, 1960, may be obtained from the above office (C.D.N. Branch) on payment of a fee of ten shillings (not refundable) for each tender.

The applications for tenders should clearly state the above reference number. C 968

FOR SALE OR HIRE

Edwards

HAMILTON NO. 425. DOUBLE SIDED POWER PRESS. Motorised for 400/3/50 supply. Pressure exerted approx. 100 tons. Stroke 5 in. Between uprights 42½ in. Bed 42 in by 32 in. Hole in bed 33 in. by 20⅜ in. Weight approx. 8 ton.

DOUBLE SIDED FRICTION SCREW PRESS. Motorised for 400-440/3/50 supply. Pressure exerted 50 tons. Stroke 9 in. Between uprights 15⅜ in. Bed 15½ in. by 20 in. Hole in bed 4½ in. diameter. Weight approx. 71 cwt.

TAYLOR & CHALLEN DOUBLE SIDED DOUBLE ACTION CAM ACTION DRAWING PRESS. Punch stroke 8 in. Blankholder stroke 4 in. Between uprights 20 in. Bed 18 in. by 15½ in. Hole in bed 8 in. diameter. Punch 4 in. diameter. Hole in punch 1½ in. diameter. Weight approx. 45 cwt.

FROST POWER GEARED SWING BEAM HIGH-LIFT UNIVERSAL FOLDING MACHINE. Motorised for 400-440/3/50 supply. Capacity 10 ft. by ⅜ in. mild steel. Adjustable for sharp and round bends. Clamping beam swings out for removal of trunk sections. With adjustable back gauge. Weight approx. 6 ton.

PELS DOUBLE ENDED UNIVERSAL PUNCHING, SHEARING AND SECTION CROPPING MACHINE. Motorised for 400-440/3/50 supply. Punches up to 1⅜ in. diameter by 1 in. thick. Depth of punch gap 24 in. Shears flat bars up to 1 in. thick. Crops rounds, tees, squares and angles in proportion. Weight approx. 8 ton.

PELS DOUBLE GEARED ALL STEEL DOUBLE ENDED ANGLE AND TEE IRON CROPPING MACHINE. Motorised for 400/3/50 supply. On turntable base for positioning in any direction. Crops angles 7 in. by 7 in. by ⅞ in. or 6 in. by 6 in. by ¾ in. Tees 6½ in. by 6½ in. by ⅞ in. On the square and on the bevel. Weight approx. 105 cwt.

BESCO UNIVERSAL SWING BEAM FOLDING MACHINE. Capacity 6 ft. 2 in. by ¼ in. Clamping beam swings out for withdrawal of trunk sections. Folding beam adjustable for sharp and round bends. With adjustable stop for repetition bending and adjustable back gauge. Weight approx. 6300 lb.

Photographs of the above are available.
Very favourable Hire Purchase terms can be obtained.

MACHINE TOOLS, NEW AND USED, Of Every Description. Attractive Prices.

F. J. EDWARDS LTD.
359-361, EUSTON ROAD,
LONDON, N.W.1.
Telephone: EUSton 5000. Telex 24264
And at
LANSDOWNE HOUSE, 41, WATER STREET, BIRMINGHAM, 3.
Telephone: Central 7606-8 G 876

ADVERTISEMENT RATES

TRADE AND TECHNICAL SECTION

AGENCIES · ANNOUNCEMENTS · BUSINESS OPPORTUNITIES · CAPACITY
CONSULTANTS · EDUCATIONAL · EXPERIMENTAL WORK
FOR SALE OR HIRE · PATENTS · PUBLICATIONS
SALE AND VALUATIONS · TENDERS · TO LET · WANTED

4s. per line (minimum charge 16s.) single column inch rate 48s.

Lines average 6 words—12 lines to the inch. Box number: 2s

SERIES DISCOUNT—5 per cent. on 6 insertions, 10 per cent. on 13, 15 per cent. on 26

DISPLAY AND ILLUSTRATED layouts are accepted
COPY DATE—first post Monday

REDUCED RATES for quarter, half and full pages—apply to "Engineering" Dept. C.A. for full information, and details of advertisements layout service.

TWI

SECONDHAND BORING MACHINES. HORIZONTAL
2 NO. 2 KEARNS MOTOR DRIVEN 3 IN. TRAVELLING SPINDLE, standard 3 phase electrics.
NO. 2 RICHARDS P.R. TYPE MOTOR DRIVEN. Arranged for screw cutting. Standard 3 phase electrics.
VERTICAL
33 IN. SWING BULLARD TYPE, Turret and Side head, single pulley drive.
38 IN. SWING WEBSTER & BENNETT DUPLEX 32 IN. DIA. TABLES, each table arranged for Independent motor drive.

THOS. W. WARD LTD.

ALBION WORKS SHEFFIELD
'Phone: 26311. 'Grams: "Forward"
LONDON: BRETTENHAM HOUSE, STRAND, W.C.2
'Phone: Temple Bar 1515 (12 lines).
Remember — Ward's might have it! G 60

GENERAL POST OFFICE

The Postmaster General offers for sale 2,335 UNUSED, CREOSOTED, STOUT TELEGRAPH POLES, ranging from 28 ft. to 36 ft. in length.

These poles are lying at sites as follows:—
CHARLTON, LONDON, S.E.7; BELVEDERE, KENT; SOUTHAMPTON; NEWPORT, MON.; BOSTON, LINCS.; BROUGH, YORKS; ELLESMERE PORT; LEVEN, FIFE and GRANGEMOUTH, STIRLINGSHIRE.

Applications for forms of tender should be made to:—
DIRECTOR OF CONTRACTS,
POST OFFICE CONTRACTS DEPARTMENT, (DISPOSALS),
TELEPHONE HOUSE,
TEMPLE AVENUE,
LONDON, E.C.4. C 963

IF YOU REQUIRE D.C. CURRENT AT 20 KV TO 40 KV PLEASE NOTE: FOR SALE, FERRANTI OIL COOLED TRANSFORMER RECTIFIER, input 400/1/50, output 20 kV to 40 kV at 375 mA, complete with controls and instruments, suitable for electrostatic precipitation, etc. Unused, low price.—L. SOLLOMAN, LTD., BEAUFORT STREET, MANCHESTER, 3. 'Phone: BLA. 4571. C 905

NEW DOUBLE END PUNCHING, SHEARING, SECTION CROPPING AND NOTCHING MACHINE, MODEL BU. 100 for sale. Shears plates up to 13/16 in., flat bars up to 1 in. by 6 in., rounds up to 2⅜ in. diameter, squares up to 2 in., angles and tees at 90 deg. 5½ in. by 5½ in. by 11/16 in. and 45 deg., 4 in. by 4 in. by ½ in. Punches up to 1⅛ in. diameter. Depth of gap 20 in. Weight 4½ tons. Arranged motor drive 400/3/50. All steel construction. Photo etc. from F. J. EDWARDS LIMITED, 359, EUSTON ROAD, LONDON, N.W.1, or 41, WATER STREET, BIRMINGHAM 3. C 941

PATENTS

THE PROPRIETORS OF PATENT NO. 749175 for ARRANGEMENT FOR YIELDINGLY COUPLING TWIN SUNWHEELS TOGETHER desire to secure commercial exploitation by Licence or otherwise in the United Kingdom. Replies to Haseltine Lake & Co., 28, SOUTHAMPTON BUILDINGS, CHANCERY LANE, LONDON, W.C.2. C 954

AGENCIES

MANUFACTURERS OF MACHINERY OF ALL TYPES, Agricultural Machinery and Implements, Diesel Engines, Marine Engines for fishing trawlers; interested in being represented by a reputable organisation in Pakistan on agency basis, please contact:
S. M. AHMED & CO. LTD.,
15, GREAT TRINITY LANE,
LONDON, E.C.4.
'Phone No.: CENtral 0075. C 912

WORK WANTED

PRATCHITT BROTHERS LTD., DENTON IRON WORKS, CARLISLE, having well equipped engineering shops and iron foundry, **INVITE ENQUIRIES FOR GENERAL ENGINEERING, STRUCTURAL AND PLATEWORK,** from firms wishing to have plans made to their own designs and specifications. G 511

'Engineering' Appointments Section

ADVERTISEMENT RATES

CLASSIFICATIONS: Public Appointments, Appointments Open, Appointments Wanted.

TYPES OF ADVERTISEMENTS:

(a) "Appointments Illustrated" and illustrated careers advertisements: photographs or drawings may be used in conjunction with type matter.

Rates per page: (12 in. by 9 in.) £100
half page £54
quarter page £29

(b) Semi-display: type matter, with or without surrounding rule, name block or symbol.

Rates: per page (12 in. by 9 in.) £100
half page £54
quarter page £29
single column inch .. .. £2 14s.

(c) Single column "run-on" advertisements: approximately 6 words to the line, 12 lines to the inch.

Rate per line .. .. 4s. 6d.
(Minimum charge 18s.

SERIES DISCOUNTS: 5 per cent. on 6 insertions; 10 per cent. on 13 15 per cent. on 26.

BOX NUMBER: 2s.

Company Meetings

Quarter page, £29; half page, £54; full page, £100.

COPY DATE: First post Monday.

BLOCKS: To be mounted ready for printing. Screen 100.

ORDERS TO: "Engineering" 36, Bedford Street, London, W.C.2. (Telephone TEMple Bar 3663)

For 'Engineering' Appointments Section, turn to the centre of editorial section.

qualified engineers and scientists:

Published by ENGINEERING "qualified engineers and scientists: analysed by profession and industry": a chart showing the distribution of the different types of professional engineers and scientists in the British manufacturing industries, building and contracting and in industrial research associations. It can be seen from this chart, for example, how many electrical engineers are employed in constructional engineering, chemicals and allied trades, the manufacture and repair of aircraft—the chart also shows the total number of engineers and scientists of all types employed in these and other industries.

analysed by profession and industry

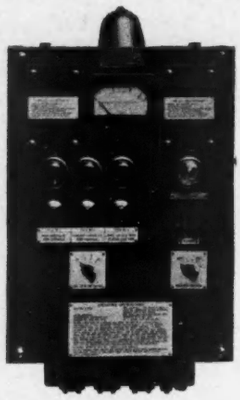
Copies of this chart are supplied *gratis* by ENGINEERING, 36 Bedford Street, London, W.C.2. Telephone: Temple Bar 3663.

Crockatt

PATENT

ELECTRIC SALINOMETERS

FOR DIESEL ENGINED SHIPS



A three-point safeguard ensures pure water

★ **CONTINUOUS CHECK ON WATER PASSING FROM EVAPORATOR TO FRESH WATER TANK.**

★ **AUDIBLE AND VISIBLE WARNING OF THE LEAST IMPURITY.**

★ **AUTOMATIC DIVERSION OF IMPURE WATER.**

Crockatt Salinometers also ensure pure water for Cylinder Cooling.

Write for details of this application of Crockatt Salinometers — also of Reseating Tool for Diesel Exhaust Valves.

W. CROCKATT & SONS LTD.

DARNLEY STREET GLASGOW, S.1

---

but the STEEL-SHAW COUPLING can take it!

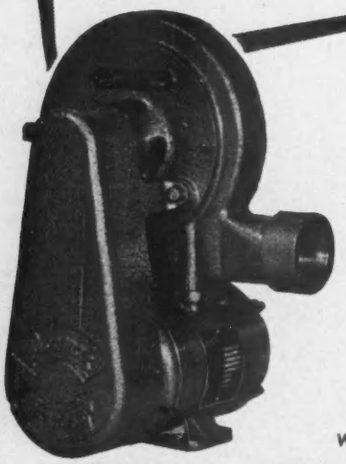
Here's a really **flexible** coupling. Its individual springs mean that it will accommodate alignment errors; absorb shock and stress; damp out vibrations yet allow free end-float under loads; have a resistance to shear of approximately fifteen times the working load. Yet when you come to look at sizes against torque, you'll find that this outstanding unit will be smaller in diameter than any other coupling you can buy. *Write for full details today.*

STEELE & COWLISHAW LTD.
NEARLY HALF A CENTURY'S EXPERIENCE IN MIXING
COOPER STREET · HANLEY · STOKE-ON-TRENT
Telephone: STOKE 23333 (5 lines) TELEX 3630
A MEMBER OF THE BAKER PERKINS GROUP

Hi there! seen the **Secomak** REG°

Hi-Velocity

A.C. BLOWERS & SUCTION FANS?



A brilliant addition to the Secomak range, Hi-Velocity is a high pressure, high performance centrifugal fan, designed **for continuous duty. It needs little if any maintenance.**

Induction motor driven, it is lighter and smaller than the conventional A.C. type hitherto necessary to give an equivalent performance. Capable of water gauge pressures from 1" to 30" and of air volumes from 5 c.f.m. to 350 c.f.m., the Hi-Velocity costs less to install and run than fans of equivalent ratings.

There are very many applications in industry where these HI-VELOCITY suction and blower fans will be found indispensable.

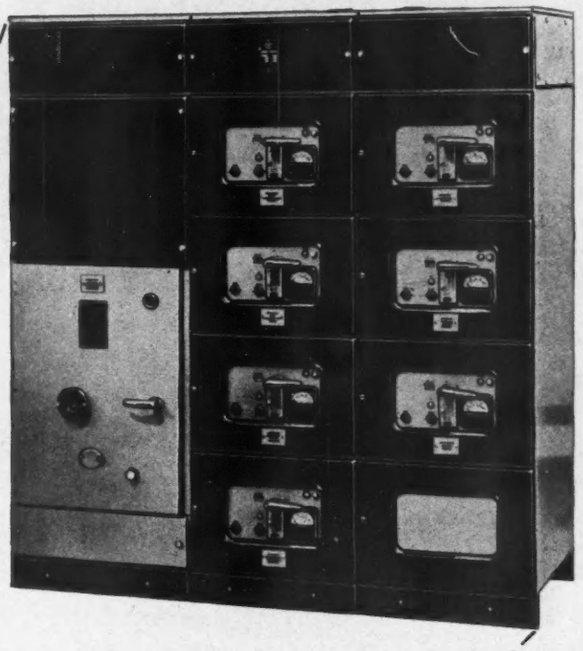
Our wide experience is at your disposal.

Write for Data Sheet HV100/Eg.

SERVICE ELECTRIC Co. Ltd.

HONEYPOT LANE, STANMORE, MIDDX. Tel: EDGware 5566-9

Stelvetite-plastic bonded to steel-has put a new face on Baldwin and Francis Switchgear Panels



SOMETHING NEW IN STEEL Until recently steel always needed periodic repainting. But not any more. Stelvetite even arrives with a finished surface in the colour you choose. *A surface finish which lasts for ever.* Stelvetite's permanent P.V.C. surface resists scratches, acids, detergents and time. Thus, in all manner of steel fabrication, Stelvetite saves on expensive surfacing processes. **It can be worked and welded as steel,** comes in a wide range of plain or embossed surfaces and is used to fabricate, among other things, lifts, doors, car panels, partitioning, furniture, kitchen equipment, walls and cladding—all of them colourful and permanent. Investigate Stelvetite. It may well save you a small fortune, or a large one.

Stelvetite Plastic bonded to Steel

**Accepted by the Council of Industrial Design for "Design Index."*

All enquiries about Baldwin & Francis Switchgear Panels should be made to Baldwin & Francis Ltd., Eyre Street, Sheffield.

STELVETITE *
—made in co-operation with BX Plastics Ltd.
made by John Summers & Sons Ltd.
who produce over 52,000 miles of sheet steel every year. Write to us at Dept. E.N., Shotton, Chester, for full information.

'Engineering' Reprint Supply Service

Single copies of these articles reprinted from 'Engineering' are available from the publisher 36 Bedford Street, London WC2 free of charge:

Your Chromium Will Soon Last Longer (courtesy of The Mond Nickel Company Limited).

Overhead Travelling Crane with Pneumatic Tyres (courtesy of Strachan & Henshaw Limited).

Hydrostatic Drives for Machine Tools, by D. Firth, A.M.I.Mech.E., National Engineering Laboratory.

Introducing Efficiency into Inspection, by P. A. McKeown, D.C.Ae., Société Genevoise Limited.

NORRIS BROS. LTD.
have teams available to undertake
DESIGN, DETAILING and DEVELOPMENT
in the following fields

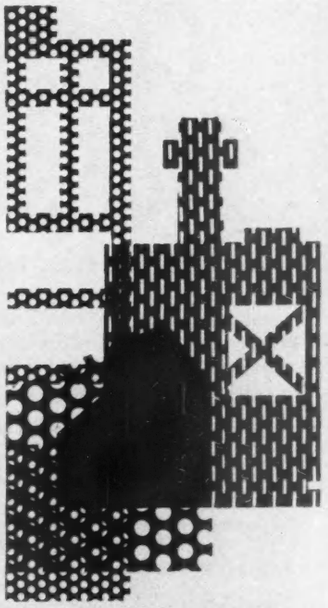
Aeronautical Engineering
Chemical Plant
Electrical Engineering
Mechanical Engineering
Mechanical Handling
Model Making
Nuclear Engineering
Plant Layout
Production Tooling
Servo Mechanisms Automation
Special Machines and Projects
Structural Engineering and Reinforced Concrete, etc.

53 VICTORIA STREET S.W.1
– TEL. ABBEY 6132 –

LOCOMOTIVES

Designers and Builders of Steam, Diesel and Diesel-electric and Battery Locomotives for all purposes. Flame Proof Diesel and Battery Locos for underground working.

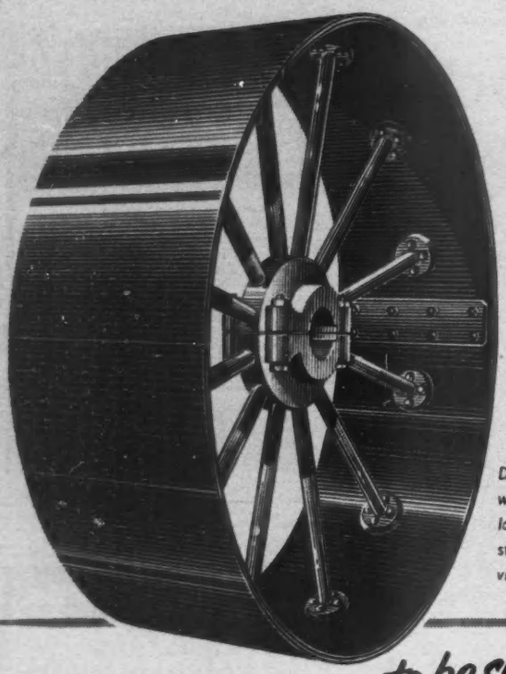
HUDSWELL, CLARKE & COMPANY LIMITED
Railway Foundry, Leeds, 10
LONDON OFFICE:
14 Hewick Place
Victoria Street, S.W.1
TELEPHONE: Victoria 6786



PERFORATED METALS FOR INDUSTRY

J. & F. Pool Perforated Metals are today giving splendid service in over 40 great industries. It is first-class equipment at the right price!

Pool
J & F POOL LTD
HAYLE, CORNWALL. Hayle 3213



Designed to withstand shock loads, alternating stresses and vibration.

to be sure...

IT'S THE *GENUINE* DOUGLAS, LAWSON

'STANCHION' PULLEY

DOUGLAS, LAWSON AND COMPANY LIMITED
BIRSTALL · LEEDS · ENGLAND

Telephone : Batley 598 & 599 Telegrams : "Pulleys" Birstall, Leeds

Clamping for Safety

with the ODONI MACHINE BED CLAMP

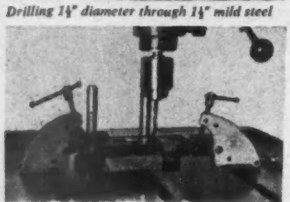
An entirely new design in Machine Bed Clamps, now in use in workshops throughout the country, is making the machining of small parts easier and safer.

The Odoni Machine Bed Clamp has these features:

Clamps any thickness from ·001in. to 2 ½in.
Fully open to fully closed in a few turns.
No spanner, packings, shims or other makeshift required.
Swivels in any direction without adjustment.
Over ¼ ton pressure can be applied.

Supplied with bolts and heavy washers for T-slots. Base fitting tapped ⅜in. Whitworth. Finished in grey hammer stove. Obtainable through Engineer's Merchants or direct from the manufacturers, price £2.17.6 per pair.

Drilling 1¼" diameter through 1¼" mild steel



Tool room drilling on die set

Precision milling on rotary table

14 day FREE TRIAL

Try a pair of Odoni Machine Bed Clamps in your own Machine shop. Send us a postcard today with your name and address—we will send you a pair of clamps by return without any obligation to purchase, and at no cost to yourselves.

Odoni

Patents applied for in principal countries

ODONI EQUIPMENT LIMITED (DEPT. 54)
79-85 SCRUBS LANE, LONDON, N.W.10 telephone LADBROKE 2948

Free! Sample Tube of MOLYKOTE® G LUBRICANT

Industry's NEWEST Production TOOL

- **ALMOST 100% SAFETY AGAINST GALLING AND SEIZING WITH ALL BEARING METAL COMBINATIONS**
- **ELIMINATES STICK-SLIP, METAL PICK-UP AND DISTORTION IN PRESS FITTING**
- **REDUCES WEAR-IN TIME AND DAMAGE IN NEW OR REBUILT MACHINERY**
- **THE HIGHER THE LOADS, THE GREATER THE MARGIN OF SUPERIORITY OF MOLYKOTE G**

HIGHLY RECOMMENDED FOR:

- **Threaded Connections**
- **Press Fitting**
- **Splines**
- **Highly-Loaded Gears**
- **Chucks & Collets**
- **Packings**
- **Drills, Taps & Dies**
- **Universal Joints**
- **Rod End Bearings**
- **Cams**
- **Dies & Punches**
- **Guide Posts**

Write for your free sample of MOLYKOTE G LUBRICANT today. We will also send you a copy of our new Bulletin 126 which gives complete details.

AFSA LTD. 25, VICTORIA ST., LONDON S.W. 1

Please send me a free sample of your MOLYKOTE G Lubricant.

NAME _____

TITLE _____

COMPANY _____

_____

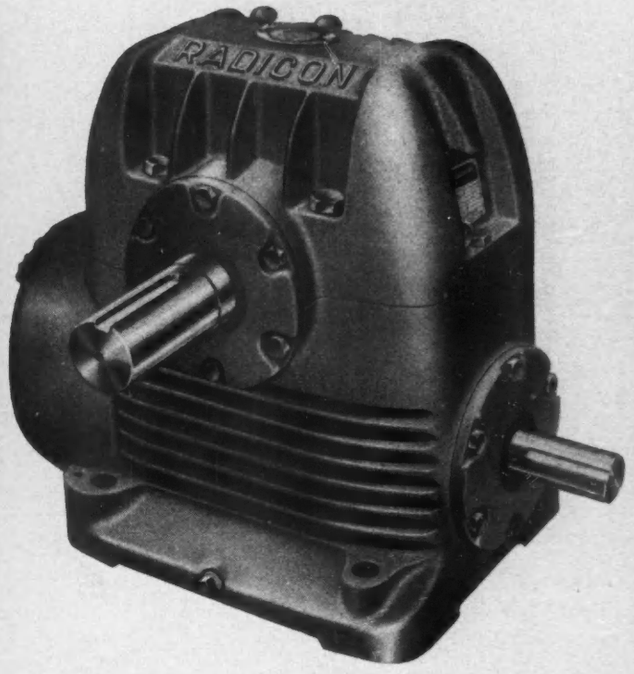
ADDRESS _____

CITY _____

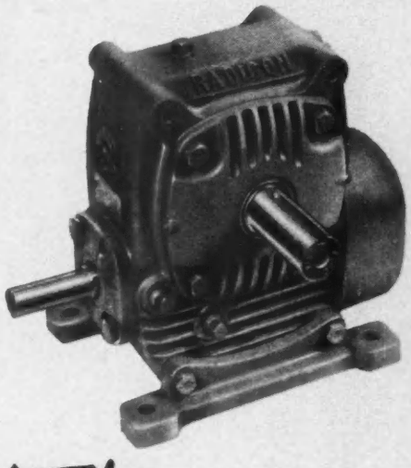
AFSA LTD.
25, Victoria St., London S.W. 1

BETTER-THAN-EVER THERMAL AND MECHANICAL RATINGS!

LESS COST AND SIZE PER HORSE POWER!



NOW FAN COOLING ON SMALL 'ADAPTABLE' UNITS



See the *NEW*

RADICON Worm Reducers

and get all the performance figures at a special EXHIBITION

at Mayfairia Rooms, Bryanston St., London, W.1

from 19th to 23rd September inclusive, from 10 a.m.

Buffet - Film Show *The Exhibition will later move to Harrogate*

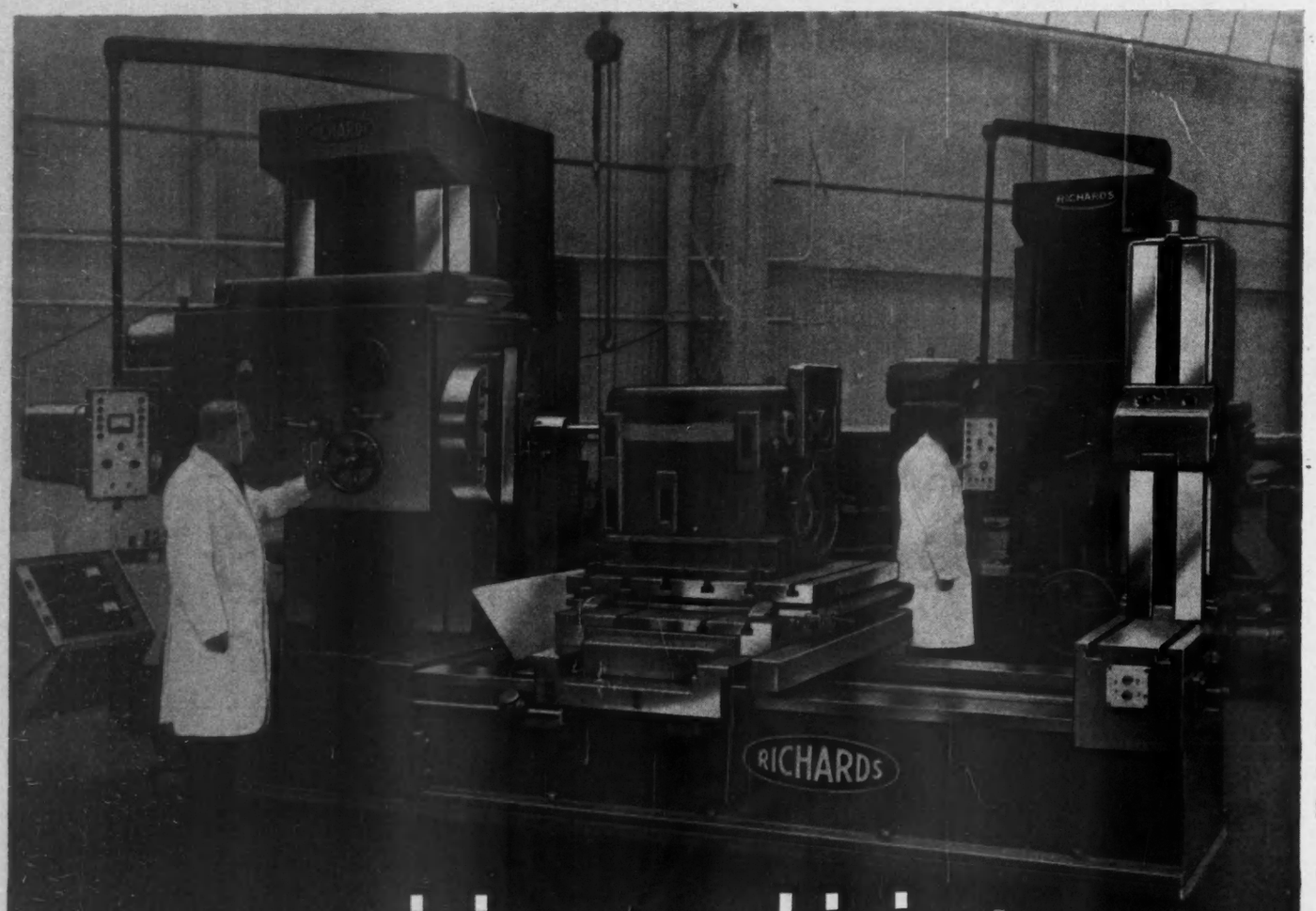
DAVID BROWN

100 YEARS 1860-1960

THE DAVID BROWN CORPORATION (SALES) LIMITED

RADICON DIVISION · PARK WORKS · HUDDERSFIELD · TELEPHONE: 3500

OA/5438



precision machining

with RICHARDS automatic co-ordinate positioning

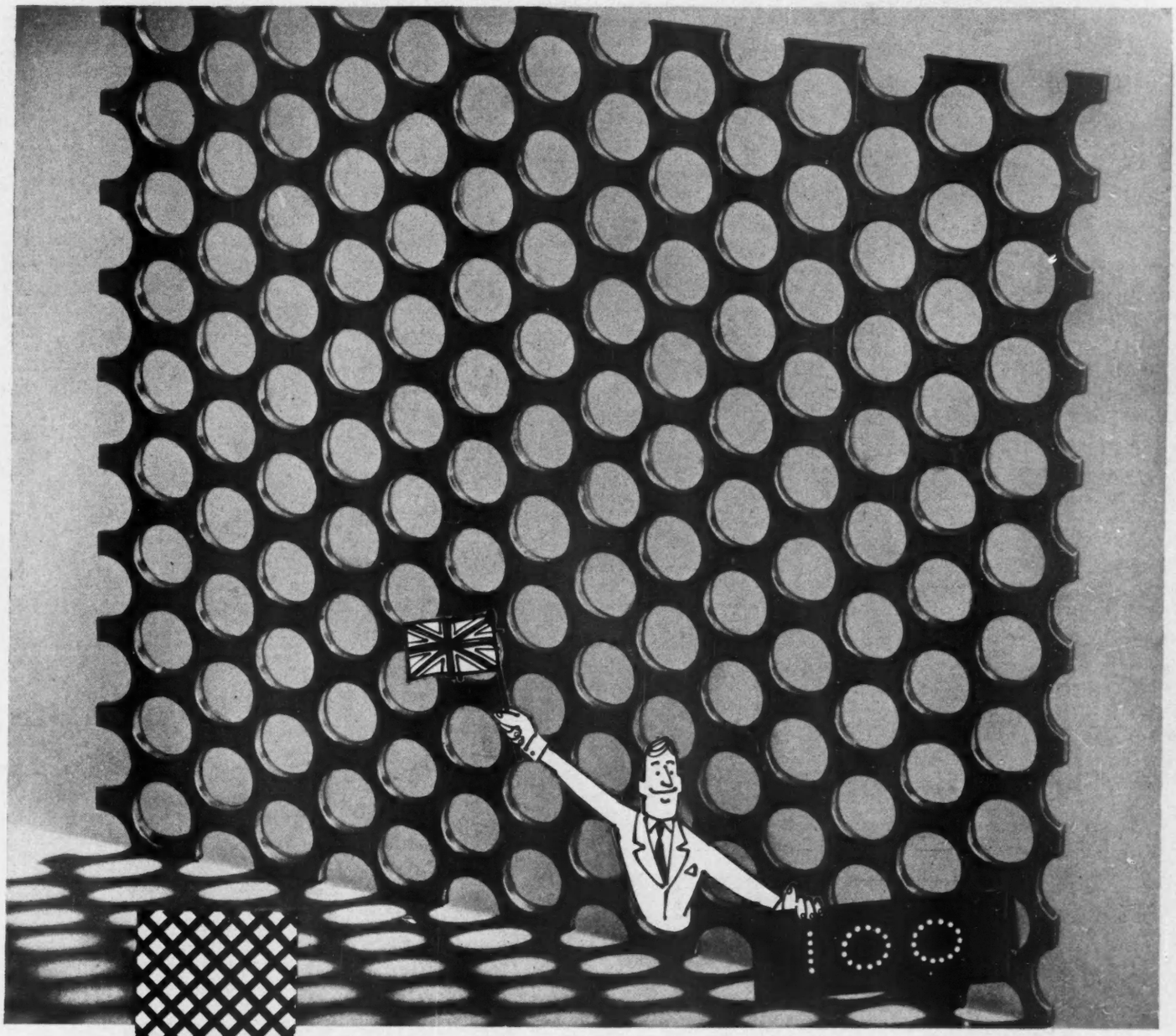
THE MACHINES ILLUSTRATED ABOVE ARE REPRESENTATIVE OF A FULL RANGE WHICH INCLUDE TABLE, FLOOR OR PLANER TYPE HORIZONTAL BORING MACHINES

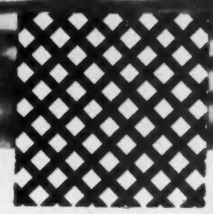
The many outstanding features associated with Richards range of Horizontal Boring Machines include models with traversing spindles from 2½" to 7" diameter, facing capacities up to 72" diameter and in the case of the machine illustrated Richards Automatic Co-ordinate Positioning unit. All machines are designed to perform heavy duty milling and a wide range of bed lengths and widths are available. Further details are given in the new range of Richards leaflets, copies of which will be gladly sent on request.

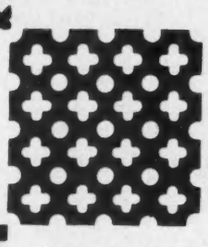
GEO. RICHARDS & CO. LTD.
BROADHEATH · ALTRINCHAM · CHESHIRE
Telephone: ALTRINCHAM 4242-7
Telegrams: RICHARDS, ALTRINCHAM
A member of the STAVELEY COAL & IRON CO. LTD. GROUP

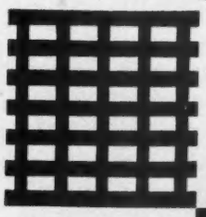
SOLE AGENTS:
ALFRED HERBERT LTD
FACTORED DIVISION
COVENTRY

R112









W. BARNS & SON (HOLLOWAY) LIMITED are proud to announce their hundredth anniversary. They extend thanks to their many clients for valued support in the past and, with the opening of their new extension last year, assure them of continued and even better service in the future.

WIRE WEAVING **BARNS** PERFORATED METALS

W. BARNS & SON (HOLLOWAY) LIMITED · Globe Works, Queensland Rd., Holloway, N.7 Tel: NORth 3347/8 Grams: Perforation, Holway, London

LOW HEAT INPUT MAKES THE BIG DIFFERENCE

HERE'S WHY!

From prehistoric times man has known the principles of fusion welding metals. Through successive civilisations the necessary techniques have been developed, and today these processes have been perfected and automated. They still rely however on fusion of two metal surfaces together, which requires high heat imput and produces permanent and undesirable changes in the crystalline structure of the metals, cracking, embrittlement, distortion and consequent weakening of the joint. The problem of obtaining an economical, high strength joint below this critical fusion-heat range remained unsolved, even in basic concept, until 1904 when Eutectic's founder, J. P. H. Wasserman, first observed the phenomenon of "surface alloying".

HERE'S HOW!

This pioneering discovery has been developed and perfected and is incorporated in Eutectic's exclusive "Low Heat Input" metal-joining process, which combines the low heat requirements of brazing with the greater strength of welding. This process using normal gas, electric arc or other heat source, produces a bond through formation of a surface alloy between the base metal and the filler metal. The surface alloy is a result of diffusion of the liquid "Eutectic Low Temperature Welding Alloy" or filler metal, into the base metal. As a result you can repair and production join most metals faster and more strongly with significant savings in time, money and materials. And what is more important the weakening distortion, warping and embrittlement of high heat methods is avoided.

HERE'S PROOF!

We invite you to see this process demonstrated free to your own satisfaction in your own works. Our local technical representative will be pleased to call on you to show any of Eutectic's range of over 150 specialised alloys and fluxes in relation to your own maintenance and metal-joining problems.

SERVICE TO INDUSTRY

FREE technical advice and data.
FREE Weld Savings Report Service.
FREE Welding School training and
FREE lecture/film service.

All available through any of 70 local technical representatives.

Post the form below for fuller details.

ORIGINAL
Low Temperature
EUTECTIC
WELDING ALLOYS

EUTECTIC WELDING ALLOYS CO. LTD.
NORTH FELTHAM TRADING ESTATE · FELTHAM · MIDDX · Phone: FELtham 6571

Plants in London, New York, Lausanne, Paris, Frankfurt, Montreal, Johannesburg, Bombay, Me bourne, Tokio, Mexico City, Puerto Rico and Sao Paulo
Research Centres in U.S.A. and Switzerland
Affiliates in Brussels, Vienna, Caracas, Lima and Buenos Aires

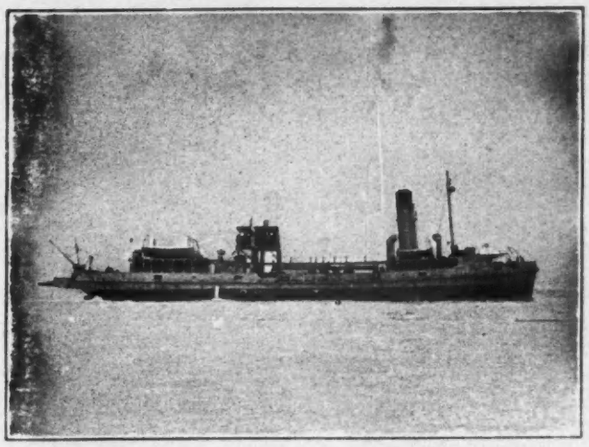
EUTECTIC — PLEASE SEND

☐ FREE 68 PAGE DATA BOOK
☐ WELD SAVINGS REPORT SERVICE

NAME .....

BUSINESS ADDRESS .....

ENG 20



TWIN SCREW SUCTION HOPPER DREDGER "MANDOVI"
constructed for the
WEST OF INDIA PORTUGUESE GUARANTEED RAILWAY CO. LTD.
Dimensions : 175 ft. × 32 ft. × 13 ft. 6 ins. moulded.
Hopper capacity : 500 tons Speed Loaded : 9 knots.

DREDGING PLANT

TO THE LARGEST DIMENSIONS AND CAPABILITIES

PATENT CUTTER SUCTION DREDGERS, PATENT DIPPER DREDGERS, BUCKET HOPPER DREDGERS, SUCTION HOPPER DREDGERS, HOPPER BARGES, PIPE LINES FLOATING CRANES, etc.

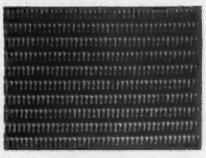
NEW BUCKETS, LINKS, PINS, GEARING, etc., supplied for existing Dredgers.

FLEMING & FERGUSON, Ltd.

SHIPBUILDERS & ENGINEERS, PAISLEY, SCOTLAND.
'Phone: Paisley 4121 *Teleg. Address: "Phenix"*
London Agents : Messrs. Nye & Marks, Ltd., Capel House, 62, New Broad Street, London, E.C.2
Telephone: LONDON WALL 4846

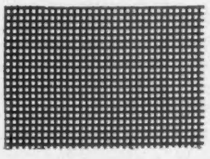
TWILLED WIRECLOTH

HOLLANDER CLOTH

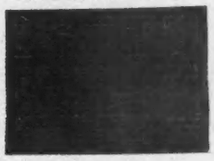


In weft counts from 50 to 2000 mesh including our MICRONIC Range of Specifications.

STRAINER CLOTH



FINE WIRECLOTH



From 100 to 400 mesh

INDUSTRIAL WIRECLOTHS IN ALL METALS MESHES AND GAUGES

Greenings
BRITANNIA WORKS
WARRINGTON · ENGLAND
P.O. BOX 22

ESTABLISHED 1799
Telephone: WARRINGTON 32401
Telegrams: GREENINGS, WARRINGTON
Telex No. 62195

NG 91

Specify MICHELL AND MAKE SURE OF YOUR BEARINGS

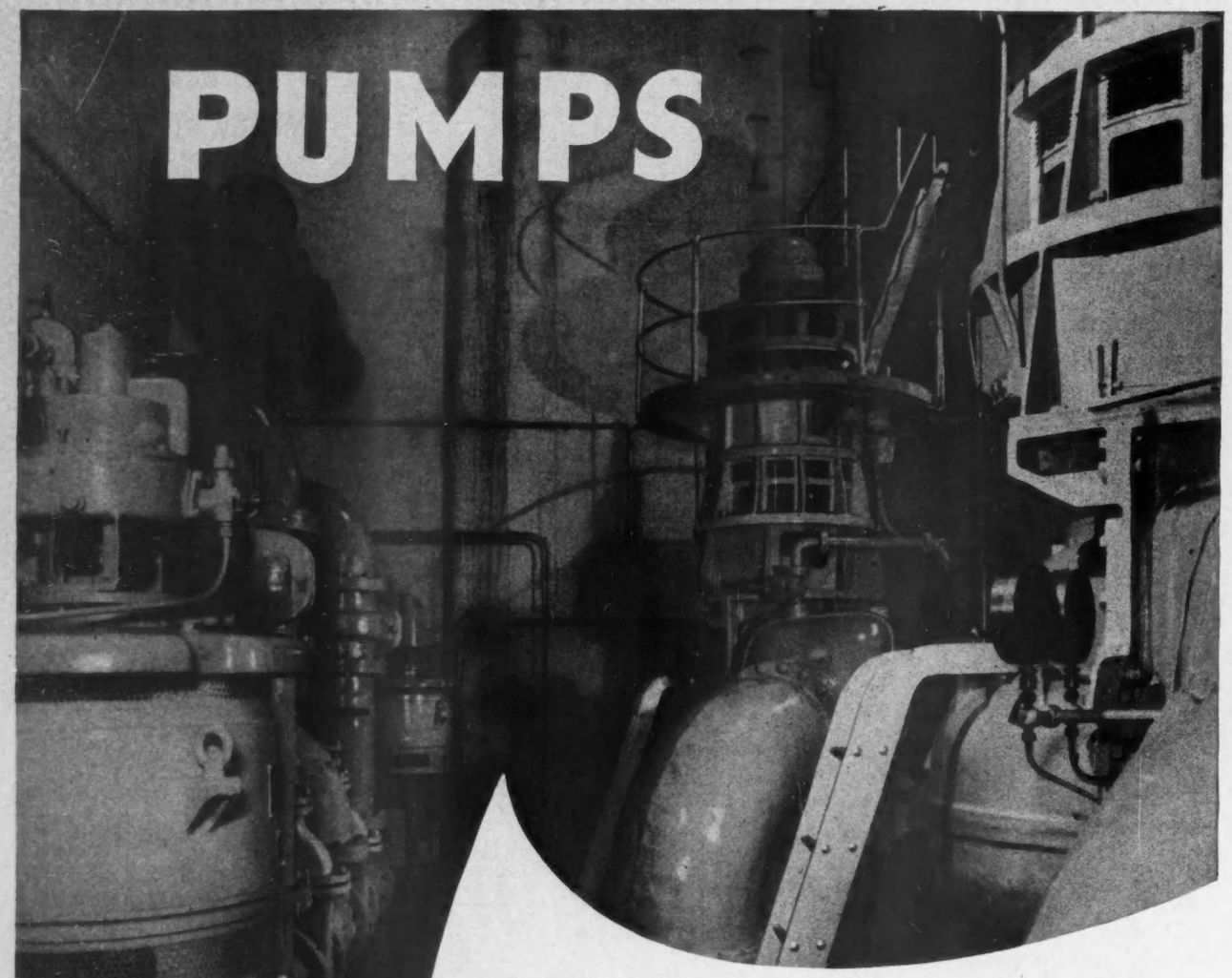
For Turbine Thrusts. Pedestal Bearings. Hydro Electrical Installations. Motors. Generators. Paper Making and Extruding Machines. Pumps. Fans. Etc., Etc.

MICHELL BEARINGS LTD
SOUTH BENWELL, NEWCASTLE UPON TYNE
Telegrams: MICHBEARO Telephone: 34279

The perfect joint compound for all screwed pipe joints

also for : Vee-Reg Valves
Velan Steam Traps
and all pipe-line accessories
Write to:—

The British Steam Specialties
LIMITED
Fleet Street, Leicester
— and Depots —



by

DRYSDALE

for high efficiency and constant reliability

Service before sales

Our Research and Development department is constantly engaged on applied research in Fluid Mechanics and other branches of engineering science.

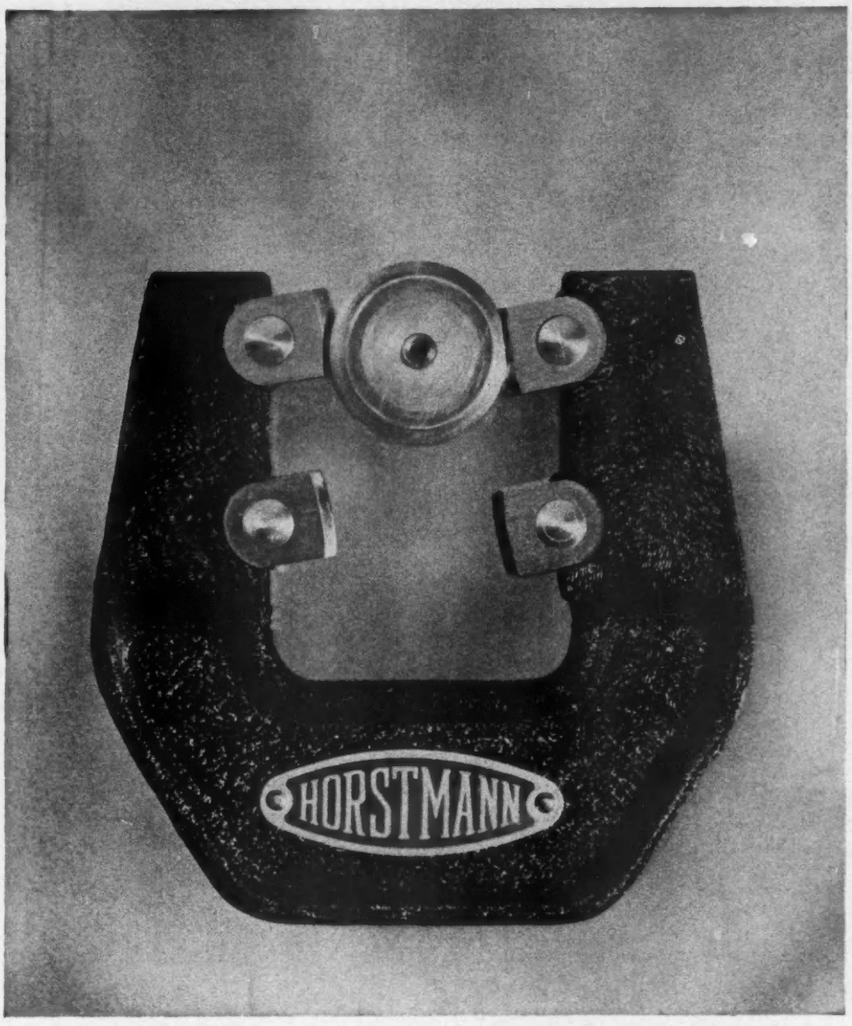
In addition, every facility is available for the experimental investigation of problems directly concerning any specific pumping application. A fund of experience is available for customers' information ensuring the most efficient and economical pumping service.

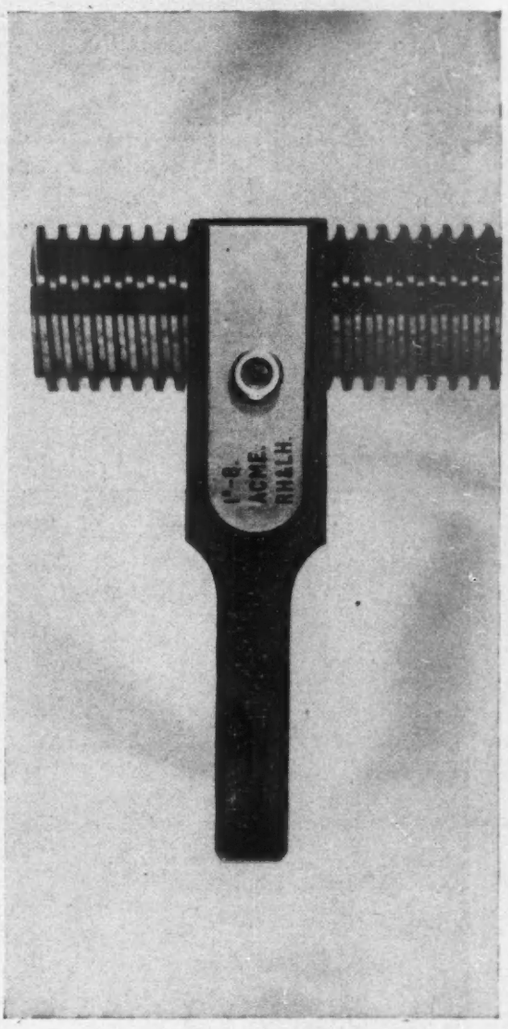
After sales service

After sales service is an important function of the Drysdale organisation. An active staff of service engineers and technical representatives is available for short notice, free advice, on the spot service, to ensure Drysdale auxiliaries operate at peak performance.

DRYSDALE & Co Ltd.
YOKER : GLASGOW

PUMP MAKERS FOR LAND AND MARINE SERVICES FOR OVER 85 YEARS





Horstmann—A gauge of accuracy

And—for good measure—the Horstmann Model 52 Screw Caliper Gauge incorporates several features which make it versatile, easy to handle and long-lasting.

One of its advantages (as can be seen from the illustrations) is that there are no projections from the side of the Caliper frame; therefore, shouldered work can easily be gauged. Adjusting screws allow for a wide range of work diameters and tolerances, and are used for readjusting to size when the gauge becomes worn. The depth of the anvil section prevents shearing and makes the Horstmann Model 52 ideal for gauging Acme forms of thread. The radiused anvils do not roll and can be used for either left- or right-hand threaded work-pieces. The Caliper is normally supplied as a ' GO ' and ' NOT GO ' combination gauge so that both tests can be applied in one action, but is also available as ' GO ' only or ' NOT GO ' only. It is manufactured in a full range of B.A., American, Unified, Whitworth and Metric forms of thread.

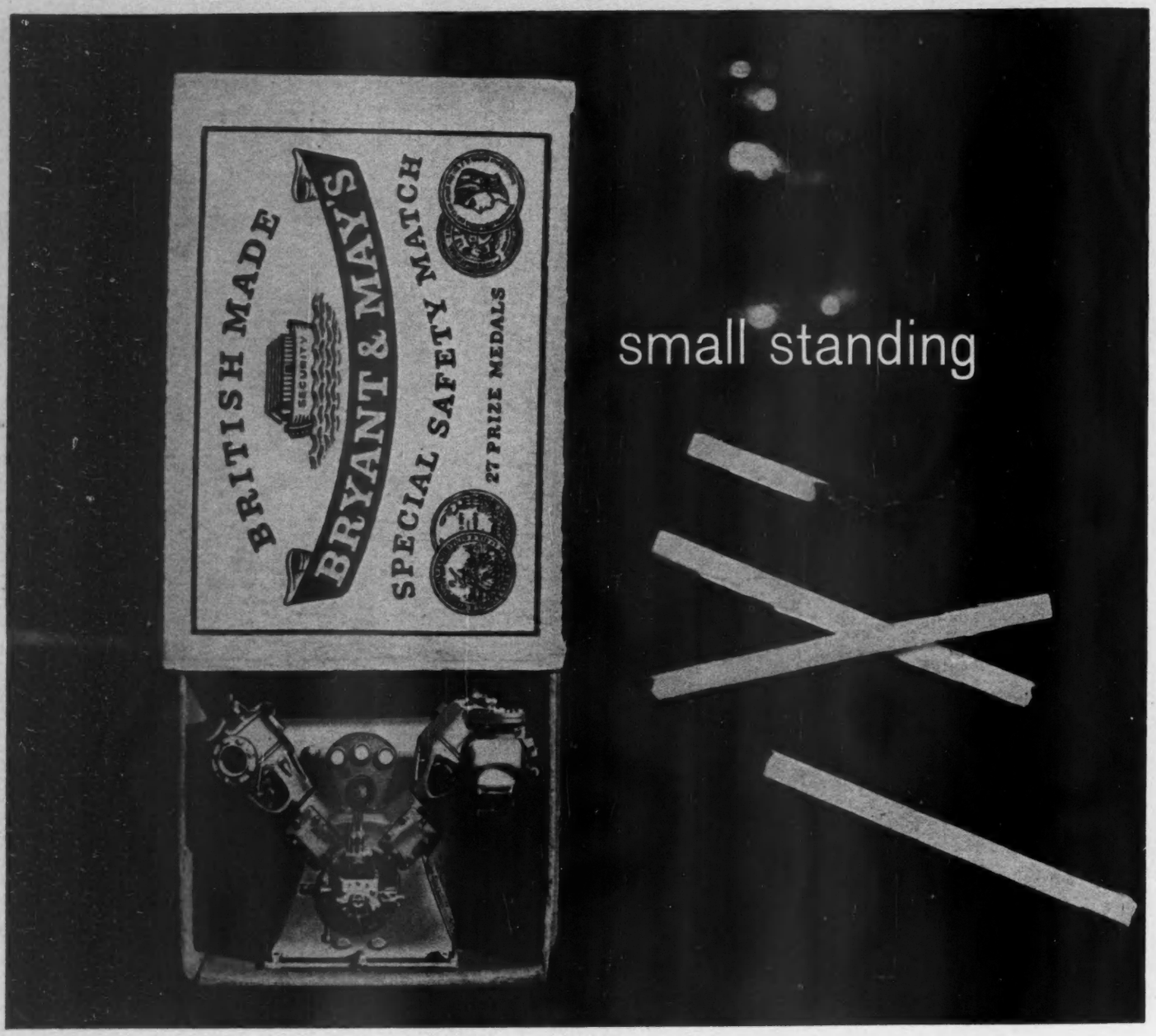
Horstmann also make screw or plain Plug and Ring type gauges. All these precision instruments are guaranteed for accuracy, hardness and finish to the requirements laid down by the National Physical Laboratory and British Standards Institution.

We shall be delighted to send you descriptive leaflets.

HORSTMANN

PLUG, RING & CALIPER GAUGES
put accuracy in your hands.

THE HORSTMANN GEAR COMPANY LIMITED
NEWBRIDGE WORKS, BATH, ENGLAND Tel: 7241



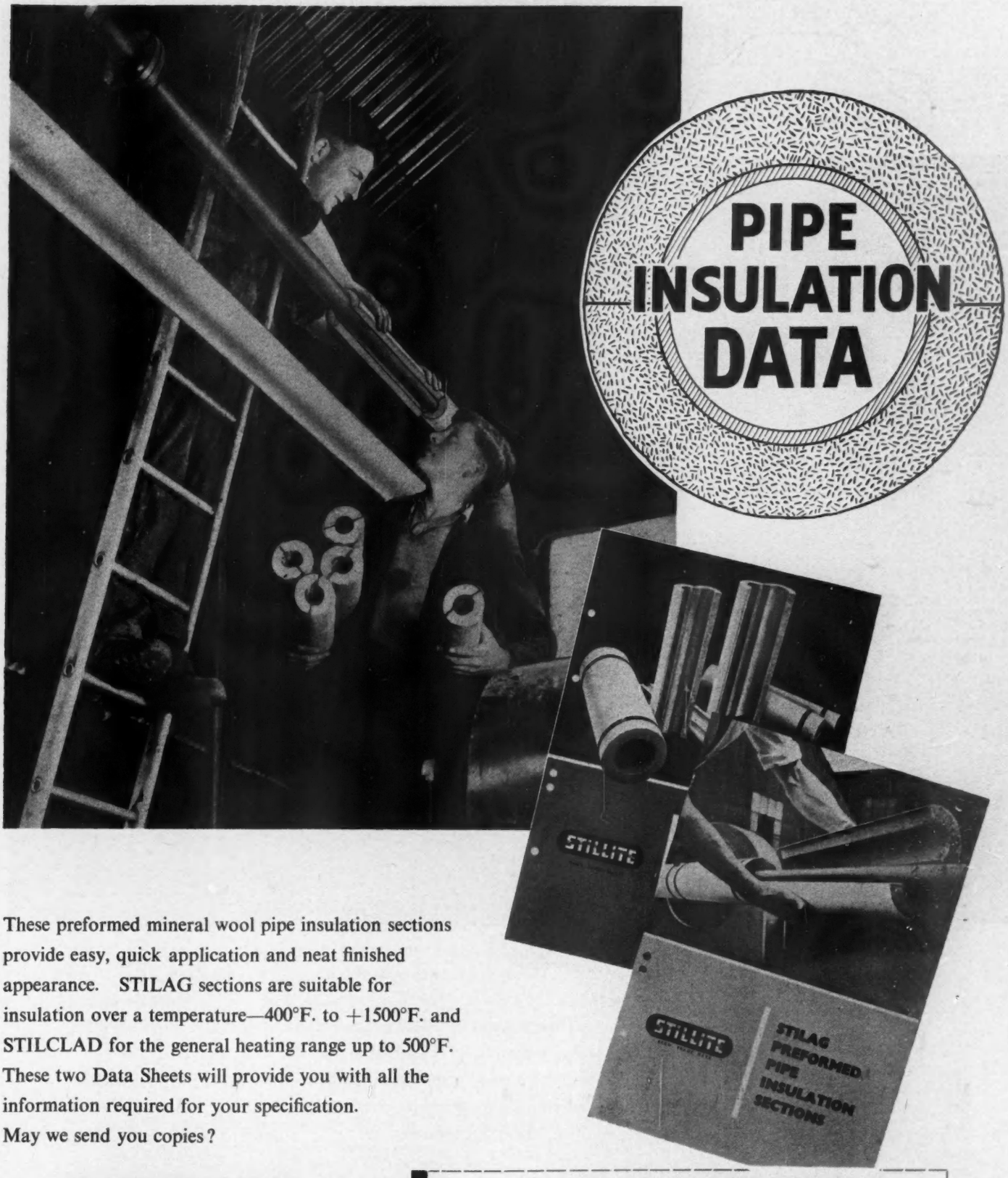
the Joy WN112 stationary compressor

Exacts less space—extracts more power. Match it against any other two stage industrial air compressor. You won't find one combining Vee-twin construction, flange-mounted motor and small floor space requirements in such striking degree.

Small-standing, country-quiet, sentry-still JOY industrial compressors are fully described in publication AD/6. Please write for a copy.

7 Harley Street, London W.1

AIR POWER
JOY-SULLIVAN LTD
DIVISION



These preformed mineral wool pipe insulation sections provide easy, quick application and neat finished appearance. STILAG sections are suitable for insulation over a temperature—400°F. to +1500°F. and STILCLAD for the general heating range up to 500°F. These two Data Sheets will provide you with all the information required for your specification.
May we send you copies?

STILLITE

Registered Trade Mark

STILLITE PRODUCTS LTD.

15 Whitehall, London, S.W.1 Tel.: WHitehall 0922/7

231 St. Vincent Street, Glasgow, C.2. Tel.: Central 4292

TO STILLITE PRODUCTS LTD.
15 Whitehall, London, S.W.1.

Please send Pipe Insulation Data Nos. 7 and 15

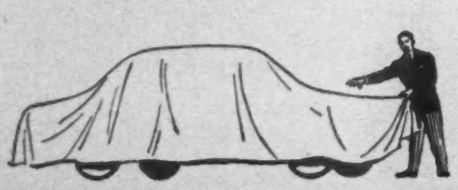
NAME .....

ADDRESS .....

.....

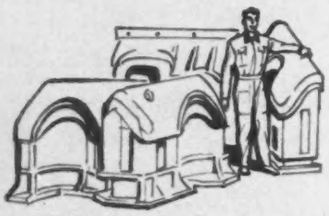
Just attach this coupon to your letterhead

ENGINEERING



A new model?

Take a sales curve and relate it to the shape of your new product. Perhaps dies come into it. Dies that are precise though large. Dies with a fine finish. Dies soundly constructed for dependability under the stresses of modern mass production press work. Vickers design them, make them, prove them, give satisfaction with them.



Dies by VICKERS

FOR YOUR NEXT PROJECT...
Talk over your requirements with Vickers at the planning stage

Vickers-Armstrongs (Engineers) Limited

DIE DEPARTMENT ELSWICK WORKS NEWCASTLE UPON TYNE 4 PHONE NEWCASTLE 33101

TGA 8H40A

BABCOCK *Cranes*

AFRICA *(Below)* A delicate operation, calling for power with accuracy; two Babcock 200-ton cranes operating together, lift a 308-ton generator rotor into place, at Kariba power station.

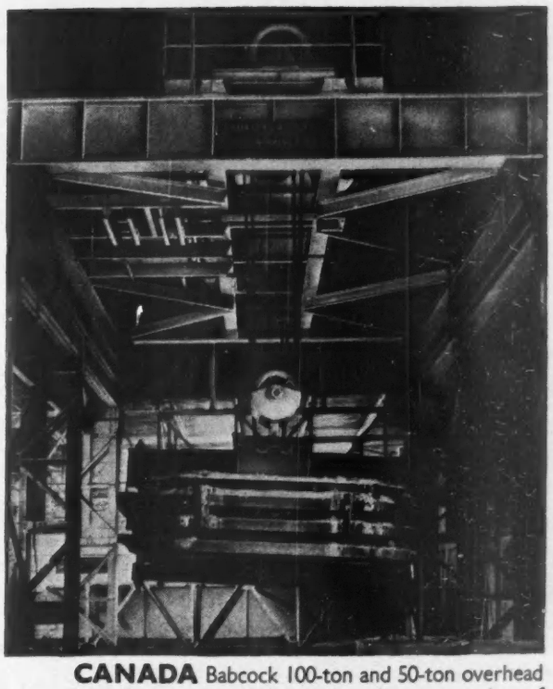
MODERN CRANES WITH A PEDIGREE

Babcock & Wilcox have been building cranes of all types for over 50 years and their overhead travelling cranes, with capacities up to 200 tons and spans up to 150 ft., are in operation all over the world, serving conventional and nuclear power stations, factories, steelworks and covered stores; and for outdoor duties in timber yards, storage areas, rail depots and gasworks etc. They have been equipped for hook-lifting, grabbing, handling bulk loads by skip or ladle; for magnetic lifting of ferrous materials, and for special duties in aluminium plants and steelworks.

A STANDARD RANGE OF OVERHEAD TRAVELLING CRANES

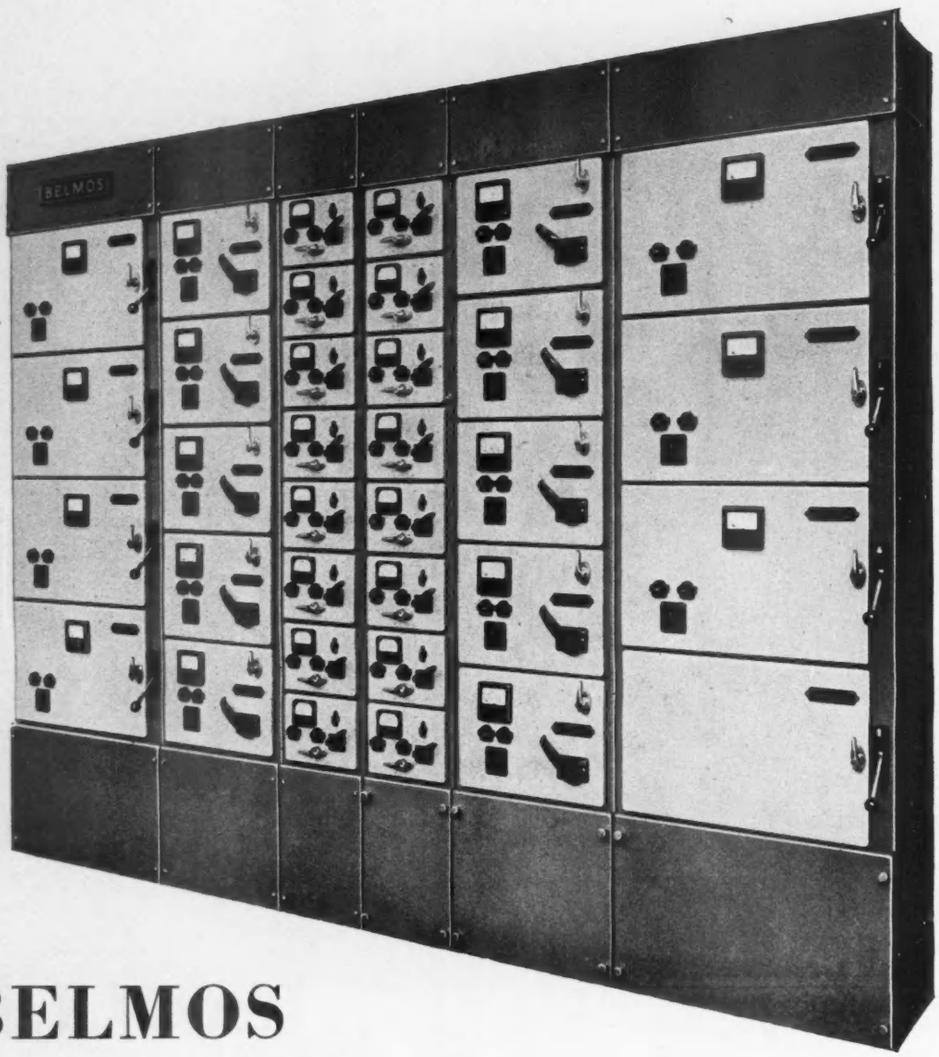
The Babcock range includes a series of *standard* overhead travelling cranes —for loads of 20 to 60 tons, spans 50 to 120 ft.—of new design and all-welded box-girder construction; with the advantages of strength, reduced weight and clean modern appearance. Standardization facilitates planning, reduces costs, improves delivery. Ask for Publication 1715.

BABCOCK & WILCOX LIMITED
BABCOCK HOUSE, 209 EUSTON ROAD, LONDON, N.W.1



CANADA Babcock 100-ton and 50-ton overhead travelling cranes serve the Baie Comeau smelter of the Canadian British Aluminium Company. Shown above; the 100-ton crane in operation.

C



BELMOS

multi-tier motor control gear

"G" RANGE

Introduced a few years ago, the "G" range of 4- and 5-tier cubicles has become firmly established for group control of motors up to 90 h.p. at 440 volts. The enclosures have now been further developed to incorporate several additional features, including automatic sequence starting and individual earth leakage protection.

"H" RANGE

The 8-tier cubicles of the "H" range accommodate contactor starters suitable for 7½ h.p. motors. The contactors are mounted in plug-in chassis which can be withdrawn for maintenance. As the photograph shows, "G" and "H" range units can line up together to form a flush-fronted controlboard.

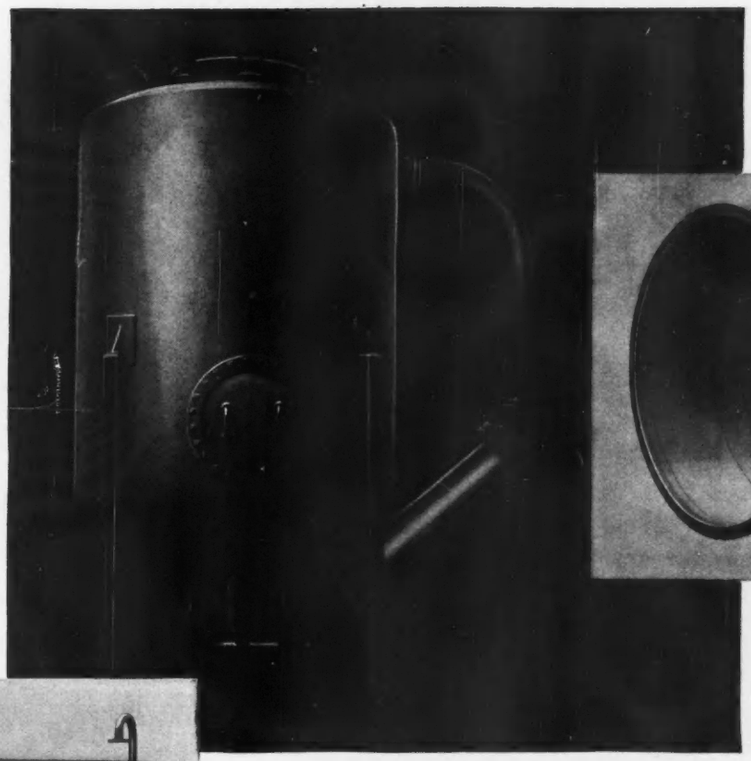
Belmos motor controlgear is suitable for most kinds of industrial applications; from paper mills to coal preparation plants, from chemicals to textiles. By virtue of the flexibility of the basic design, controlboards can be constructed from Belmos standard units to comply with customers' requirements as precisely as "custom-built" equipment. They are especially suitable for large continuous process plants and our technical staff will be glad to assist customers in planning control gear installations to meet their particular needs.

Belmos

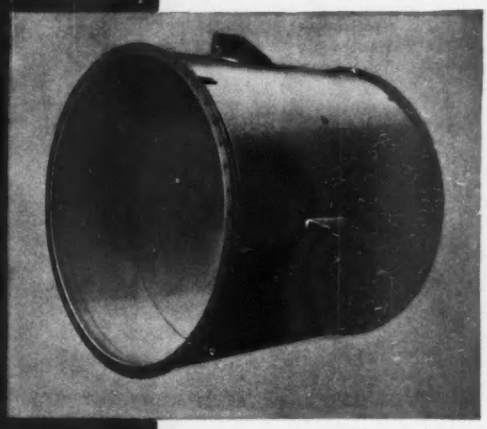
the Belmos company limited

BELLSHILL · LANARKSHIRE

LONDON · GLASGOW · BIRMINGHAM · NEWCASTLE · MANCHESTER · SHEFFIELD · CARDIFF

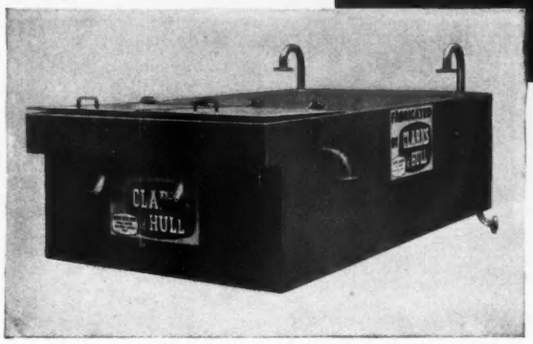


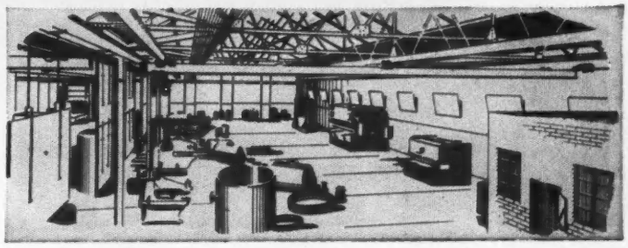
1,000 gall. kettle in ¼" copper. Lynx Quasi-arc welded.



Stainless steel vessel with mild steel jacket

12,000 gallon water separator





WELDED FABRICATIONS

ORDINARY OR EXTRAORDINARY

CLARKS CAN COPE

STAINLESS STEEL, MILD STEEL, ALUMINIUM FABRICATIONS COMPLETE WITH VALVEWORK AND PIPEWORK

METALLIC ARC WELDING

ARGONAUT AND ARGON-ARC WELDING

STRESS-RELIEVING AND TESTING FACILITIES

Clark's modern methods, efficient equipment, unique facilities and practical approach all operate to your advantage....

Clarks offer you a unique combination of the most advanced equipment and methods with a century-old reputation for high craftsman standards on every type of fabrication work.

Stainless steel, mild steel, aluminium, copper or aluminium-bronze... Clarks of Hull will not only give you the practical solution to your problem—they'll deliver a first-class job on time!

Send that enquiry *first* to Clarks of Hull.

CLARK

GEORGE CLARK & SONS (HULL) LIMITED
HAWTHORN AVENUE, HULL

Telephone 37654 Telegrams 'Clark Hull'

A MEMBER OF THE NEWMAN HENDER GROUP

No. 1071
G.M. Gate Valve

(Left) To B.S. 1952. With flanged ends.

No. 1028B
Globe Steam Valve

(Centre) Renewable stainless steel seat and valve, 300 p.s.i. Up to 600°F. The most reliable valve of its class ever produced.

No. 1031
G.M. Globe Valve

(Right) With metal seat. Produced to B.S. 2060.

Top value in steam valves -from Peglers

UP TO 'BS' AND BEYOND!

High quality—in workmanship, materials, valve design . . . This is a characteristic of *all* Peglers steam valves. Whilst most are produced to B.S. standards, some stock valves, such as the highly-advanced 1028B steam stop valve, actually go beyond B.S. requirements!

NEW Advanced Features:

Peglers improved non-heating handwheel
This 'ever-cool' wheel is now fitted as standard on all Peglers steam valves. Pleasant to grip. Red enamel finish.

Coded for rapid identification
Colour-coded identity discs are fitted at the centre of handwheels, indicating valve pressure and temperature ratings, and B.S. number.

ENGINEERS!

Send now for your copy of Peglers new 1960 Catalogue

When writing please state name of your Company and position you occupy

Peglers range includes: Copper Alloy Globe, Check and Gate Valves, as well as Radiator Valves and Unions — all to B.S. requirements.

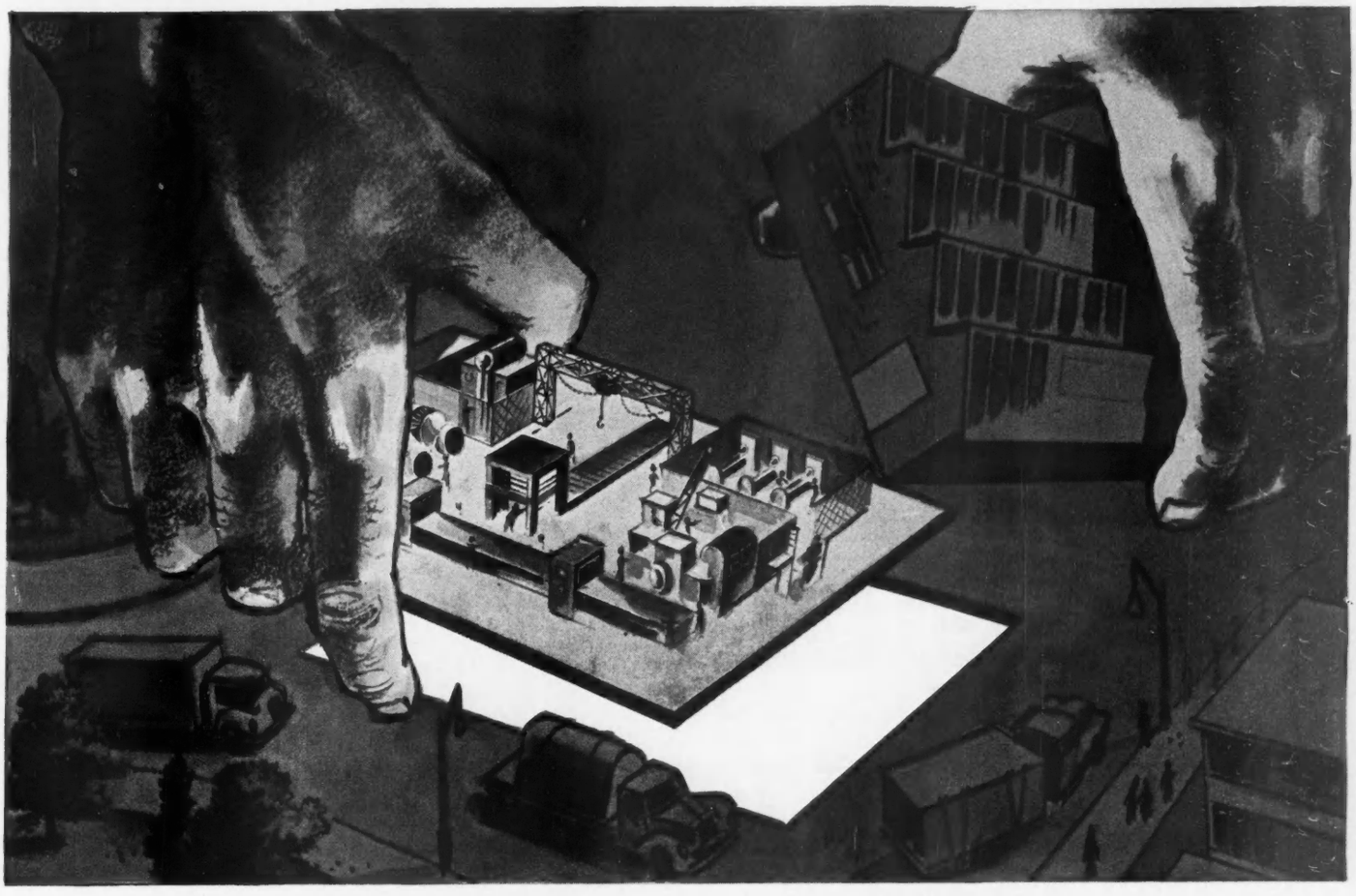
Peglers Limited
The name is the guarantee

PEGLERS LIMITED, (Dept EE) **BELMONT WORKS, DONCASTER**

London Office and Warehouse: PRESTEX HOUSE, MARSHALSEA ROAD, SE1

Also at 28 Thorp Street, Birmingham, 5

TGA. 5H98



TRANSPLANTING

MOVING a plant is a problem to many other people than gardeners. Transferring your plant and machinery to a new site calls for considerable thought and generalship if production is not to be held up unduly. This is a very good reason why you should consult us at an early stage. We can plan and undertake the complete operation ourselves, without sub-contracting. Dismantling, packing, moving and reassembly are all done by our own expert teams.

THE PLANT ENGINEERING ORGANISATION

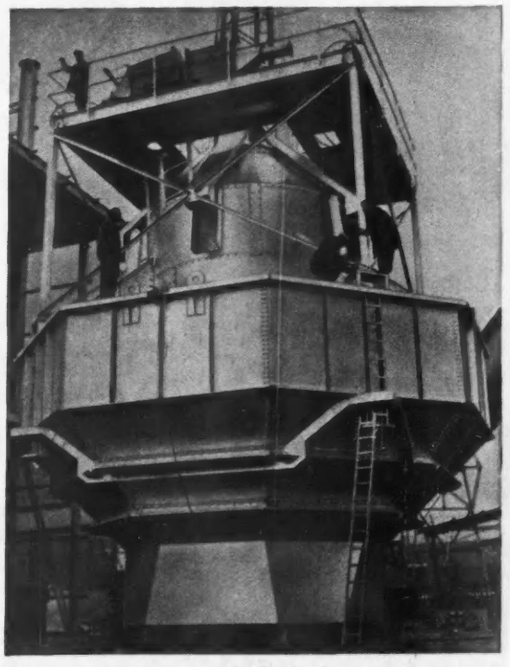
incorporating

PLANT ENGINEERS (MECHANICAL & HANDLING) LTD.

PLANT ENGINEERS (INDUSTRIAL INSTALLATIONS) LTD.

PLANT ENGINEERS (HEATING & VENTILATING) LTD.

P.E.T. (CRANE HIRE) LTD.



A hopper weighing approximately 50 tons built on site by us and placed on a concrete batching plant 65 ft. high at Fulham, London.

The Contract Removal Specialists

ENQUIRIES DEALT WITH IMMEDIATELY AT LONDON OFFICE 6 PARKWAY, CAMDEN TOWN, N.W.I. PHONE: GUL 1388

KNOW YOUR BEARINGS

Apprentices
Draughtsmen
Designers
Production Engineers
Purchasing Officers

No 3
The Magneto Bearing

This bearing, designed more than 50 years ago, is a particular version of the angular contact bearing and is designed so that the outer race is readily detachable. This is advantageous during assembly and dismantling on certain applications and is assisted by the races of magneto bearings being interchangeable.

Today this bearing is sold in very large numbers for a variety of high speed applications and where ease of assembly and dismantling is essential.

HOFFMANN MAGNETO BALL BEARINGS
are made in one series only
IN METRIC SIZES FROM 5 to 20 m.m. bore

HOFFMANN

Manufacturers of precision ball and roller bearings—established 1898

THE HOFFMANN MANUFACTURING CO. LTD · CHELMSFORD · ESSEX
TELEPHONE: 3151 · TELEX No. 1951

STAINLESS STEEL TUBE COUPLINGS

DONALD BROWN (BROWNALL) LTD.

Brownall

Catalogue H.S.60

DONALD BROWN (BROWNALL) LTD.
STEEL DIVISION
ELLESMERE ST., OLDHAM RD.
FAILSWORTH
Nr. Manchester
Telephone FAI 2399 & 4615

Ferranti to supply
one of Europe's largest transformers

Ferranti giant transformer

for Britain's super grid

The Central Electricity Generating Board are up-rating the transmission line between Monk Fryston and High Marnham, to operate experimentally at 380 kV. They have entrusted Ferranti Ltd. with the contract for one 400,000 kVA, 3 phase, 50 cycles, 380/275 kV Auto-Transformer for installation at Monk Fryston Substation. This, and the companion transformer at the other end of the line, will be the largest ever ordered in Europe. Integral high-speed On-load Tap Changing Gear will be provided.

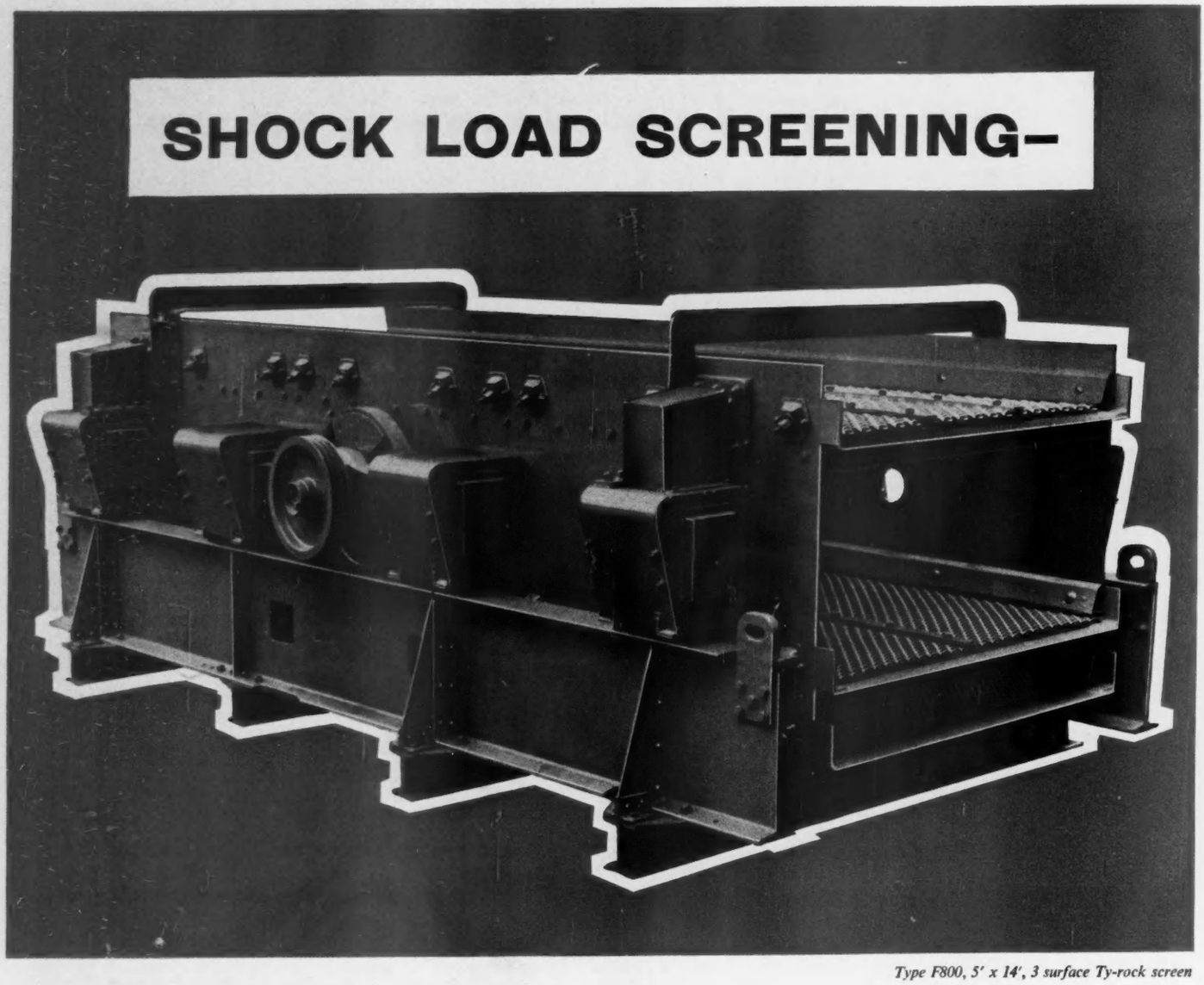
FERRANTI

FIRST INTO THE FUTURE

FERRANTI LTD · HOLLINWOOD · LANCASHIRE · Tel: FAIlsworth 2000
LONDON OFFICE: KERN HOUSE, 36 KINGSWAY, W.C.2. Tel: TEMple Bar 6666

FT254/2

SHOCK LOAD SCREENING–



Type F800, 5′ x 14′, 3 surface Ty-rock screen

with the TY-ROCK full floating screen

The Ty-rock full floating screen can handle shock loading of materials fed at inconsistent feed rates.

The massive rubber mountings of the screen suspension system are designed to withstand the shock of heavy materials feeding into the screen without the balance or efficiency of the screen being impaired.

Because of its high capacity and rugged construction, the Ty-rock screen is extensively used for screening crushed rock, gravel, ores, coal and many other materials.

For further details of the range of Ty-rock screens available with one, two or three screening surfaces please write to:—

IC

INTERNATIONAL COMBUSTION PRODUCTS LIMITED

Member of Atomic Power Construction, Ltd. One of the British Nuclear Energy Groups.

LONDON OFFICE: NINETEEN WOBURN PLACE, W.C.1 TELEPHONE: TERMINUS 2833 WORKS: DERBY.

TGA TG10

The silent firefighter

This fire ventilator saved a plant worth £3,500,000

It could well save yours

As any fire chief will tell you, fire in an unventilated area quickly produces choking, superheated smoke and fumes —conditions which keep firefighters out of the building and make effective firefighting virtually impossible. Perforation of the roof is the only remedy, but this is a hazardous operation which often endangers the life of the fireman.

The Colt Dual Purpose Ventilator has a special device that's acutely sensitive to heat. It opens *automatically* at a pre-determined temperature, releasing smoke, heat and fumes, keeping the fire localised. Firemen can enter the building, find the seat of the fire and extinguish it—with minimum damage to plant and equipment.

Colt dual-purpose ventilators have the added advantage that under manual control they can be used for normal plant ventilation and provide excellent day-to-day working conditions.

Widespread adoption by industry is proof of managerial faith in the silent firefighter.

COLT

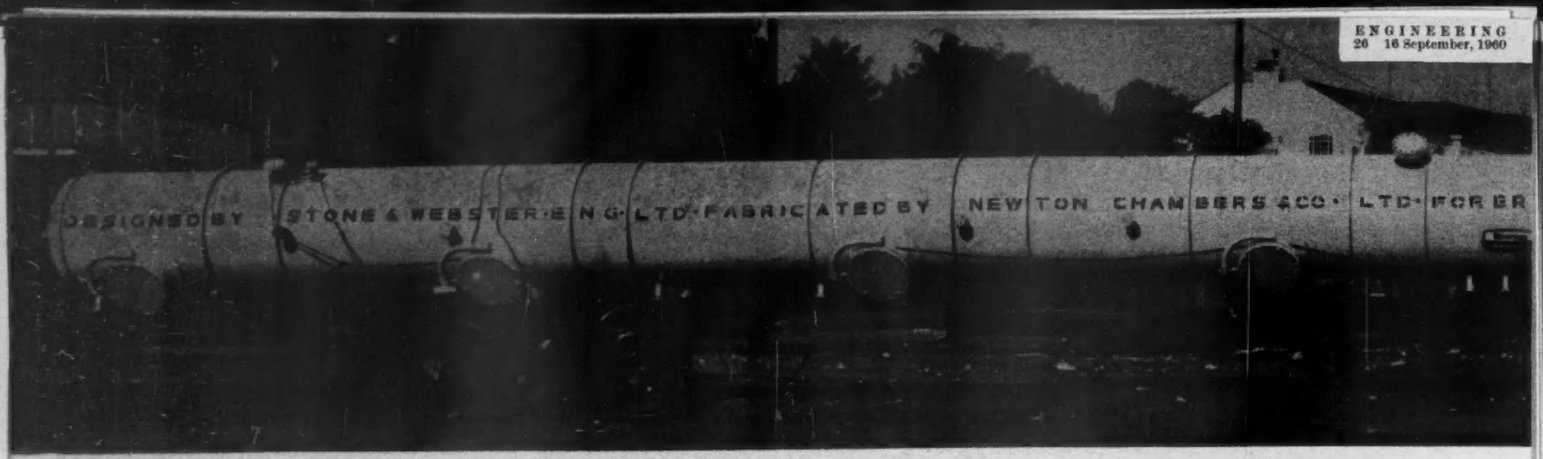
Dual-Purpose Ventilators

Automatic Fire protection—day-to-day controlled ventilation

For information write to Dept. 89 : COLT VENTILATION LIMITED, SURBITON, SURREY. ELMBRIDGE 0161

VISIT OUR STAND D46 AT THE FACTORY EQUIPMENT EXHIBITION.

D



Newton Chambers

ENGINEERING DIVISION

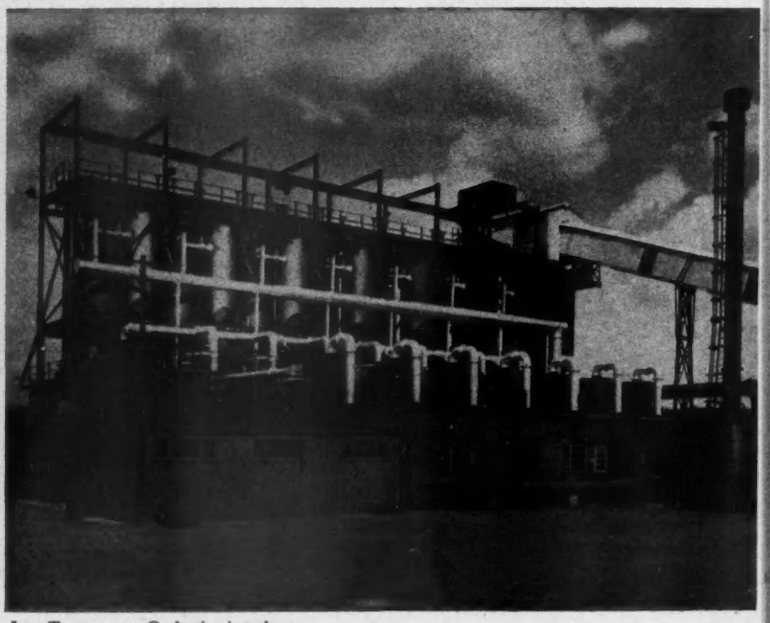
NEWTON CHAMBERS AND COMPANY LTD

THORNCLIFFE · SHEFFIELD

NEWTON CHAMBERS

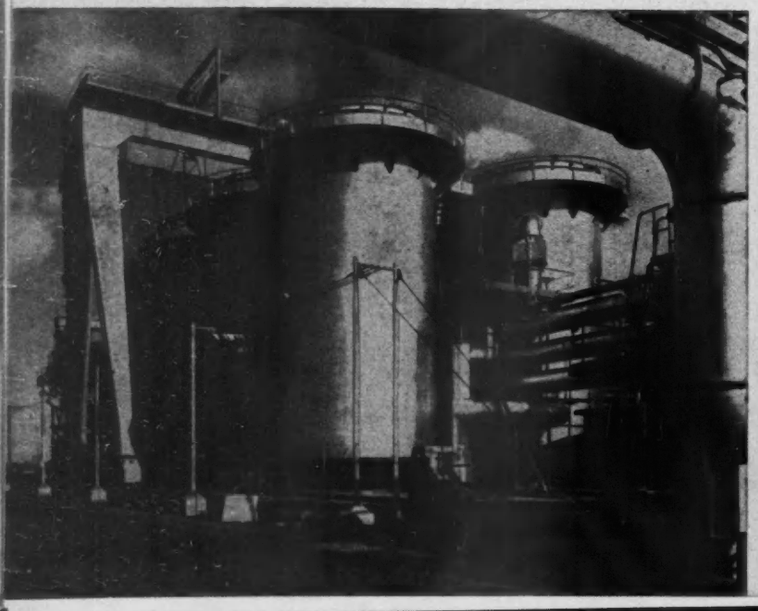
Achievements in the

Large castings in Meehanite metal

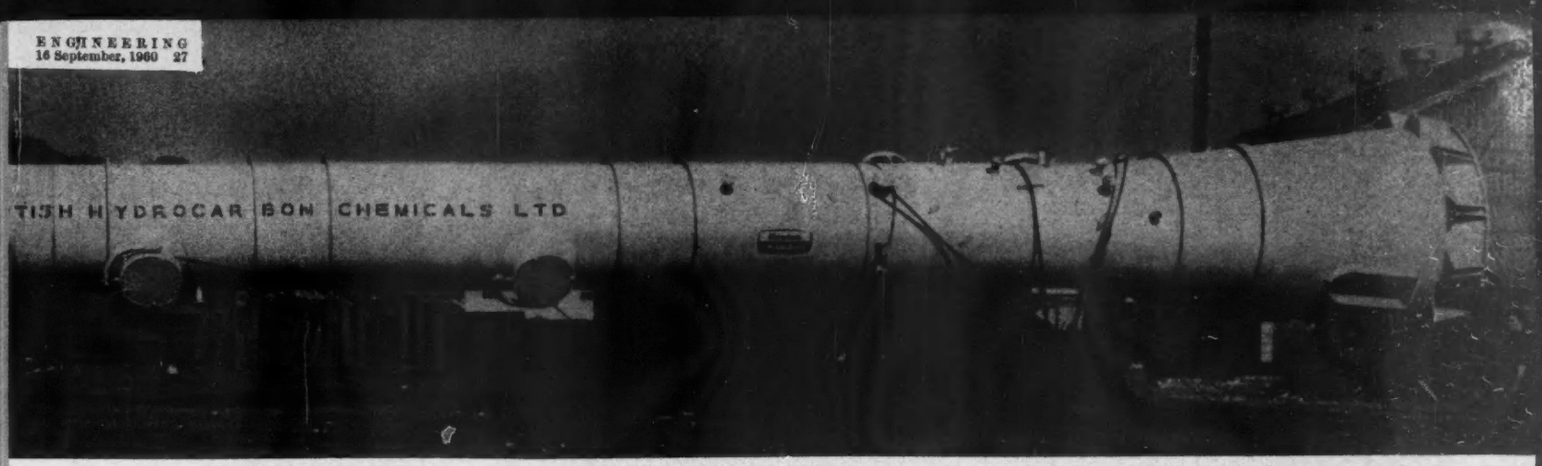


Low Temperature Carbonisation plant.

Tower purifiers with patented mechanical oxide discharger



Inka air preheater



Ethylene Tower, 118′ long, automatically welded, fully stress relieved, and X-rayed.

ENGINEERS OF PROGRESS

field of heavy engineering

Steelworks plant—ladles and transportation equipment

IRON CASTINGS of all types and sizes in all grades of Meehanite metal.

PRESSURE VESSELS, welded to class 1 Standards.

AUTOMATIC WELDING, X-ray examination and stress relieving.

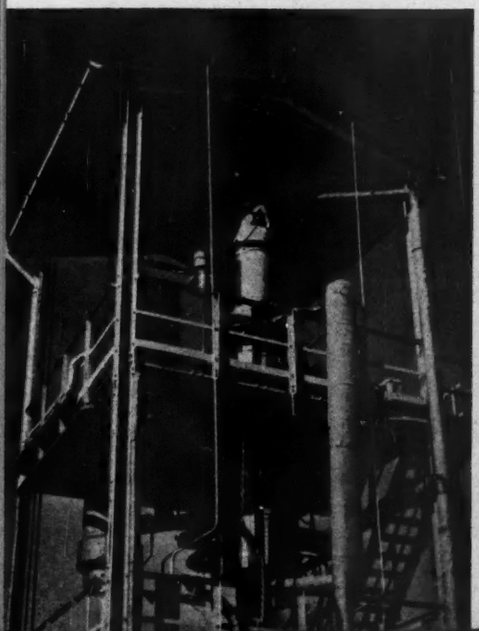
HEAT EXCHANGERS including the *INKA* Preheater, Struthers Wells direct-fired Heaters and indirect heating systems.

NEW TYPES OF HIGH PRESSURE GAS PURIFICATION and By-Product Plant, designed by Bischoff K.G., of Essen, to meet new gasmaking requirements.

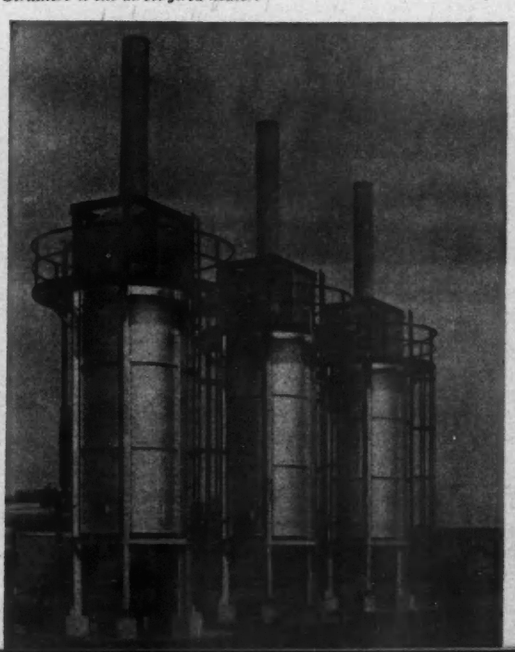
COMPLETE CENTRAL HEATING SCHEMES including the Redfyre Emma Coke Fired Boiler, giving an efficiency of at least 85%, or with the Redfyre Corner Tube Boiler for higher temperatures and pressures.

Redfyre Emma Coke Fired Boilers

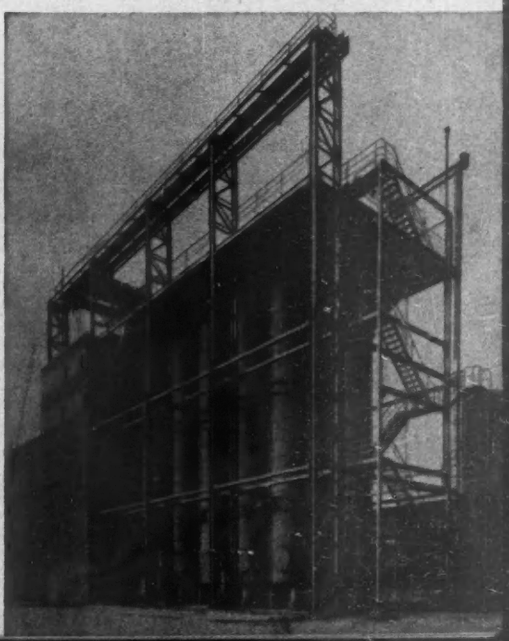
Hydro Refining Pilot Plant at Thorncliffe



Struthers Wells direct-fired heaters



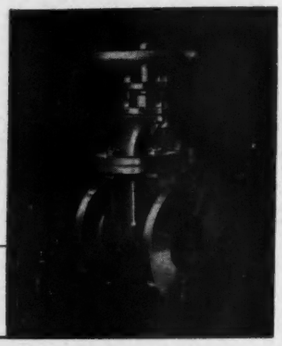
High pressure gas purification plant to Bischoff designs



ONCE AGAIN VALVES BY CRANE

At the Somerset works of Normalair Ltd. a large and well laid out plant is employed in manufacturing most of the pressurized air equipment in use in the Aircraft Industry today. A very high proportion of the valves and fittings installed here are by Crane. Their job is to control the main air supply from the compressor to the pipe lines leading to various parts of the plant. The accompanying illustration shows a group of six inch No. F52 cast iron gate valves with bronze trim, and various patterns of cast iron flanged fittings. Their high efficiency and dependability combine with well-planned grouping to give quick, easy and reliable service at all times.

Installation by W. F. Knight & Sons Ltd., Yeovil, Contracting Engineers.



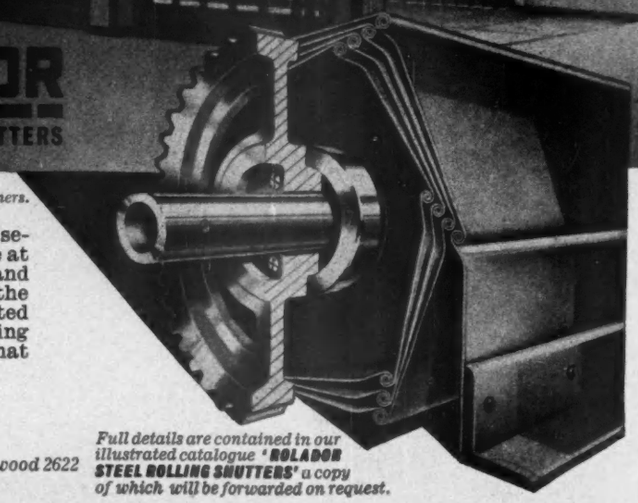
CRANE VALVES OF BRONZE, CAST IRON AND STEEL

CRANE LTD., 15-16 RED LION COURT, FLEET STREET, LONDON, E.C.4 WORKS: IPSWICH

Branches: Birmingham, Brentford, Bristol, Glasgow, Leeds, London, Manchester

S.P.D. Depot, Woking. Consulting Engineers: Messrs Frederick S. Snow & Partners.

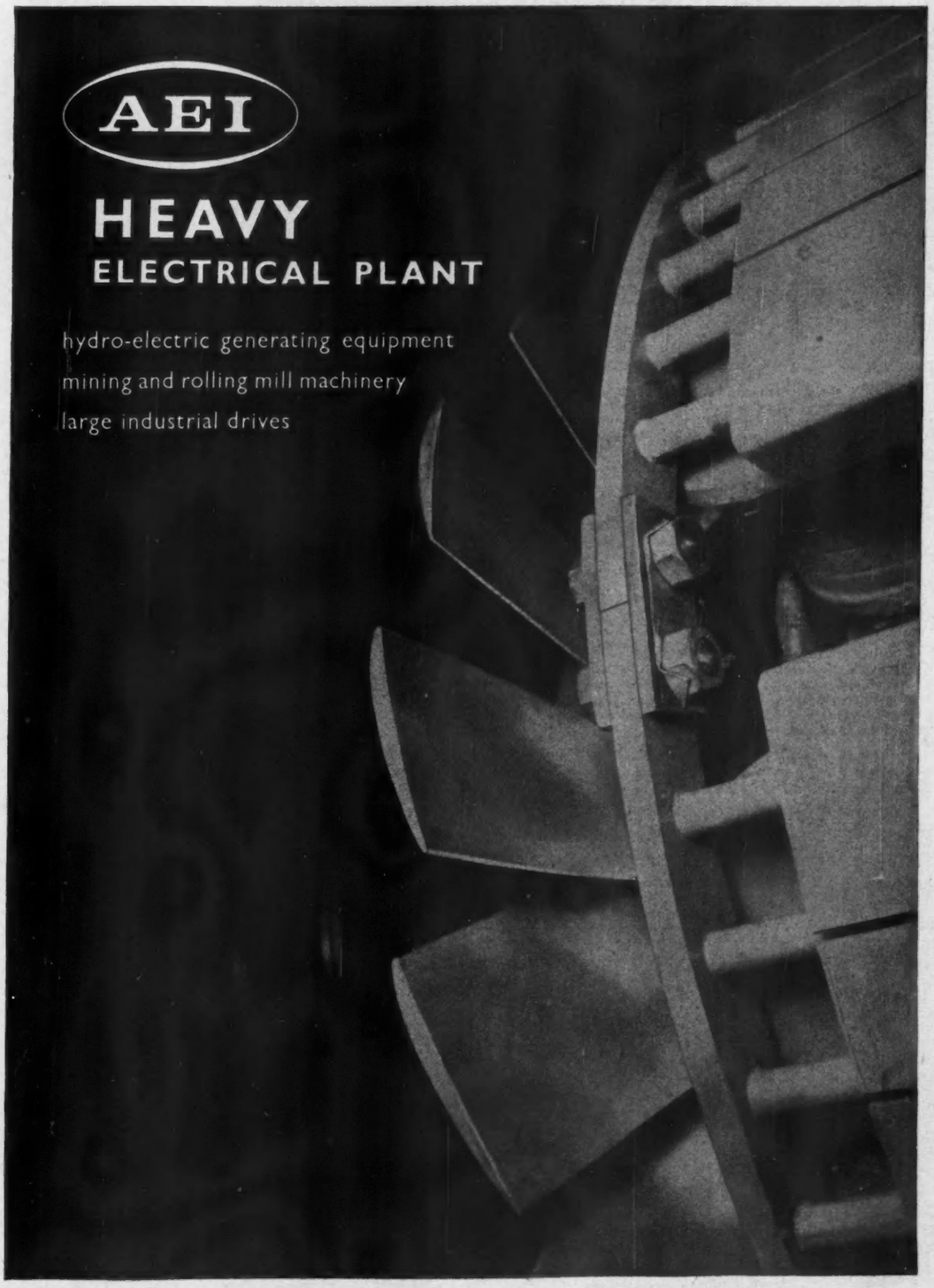
A ROLADOR Steel Rolling Shutter installation ensures security, efficiency, smooth operation and trouble free service at all times and under all conditions. The smooth coiling and operation is the result of accurate calculations made at the design stage to ensure a perfectly balanced shutter. Graduated slat widths, so essential to the lasting efficiency of a rolling shutter, are carefully determined for each installation so that they rest accurately round the hexagonal collared barrel.



Haskins ROLLING SHUTTERS & GRILLES

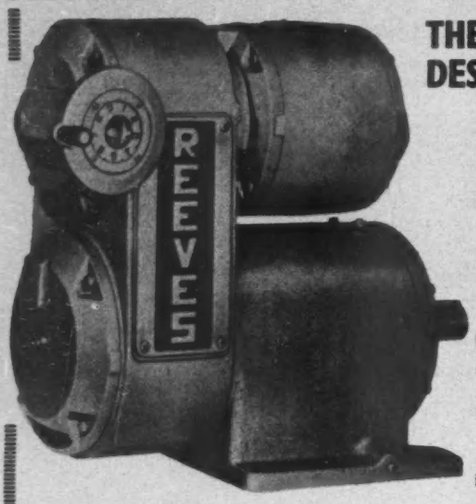
Gnome House, Blackhorse Lane, Walthamstow, London, E.17. Tel: LARkswood 2622 and Brook Street, Basingstoke, Hants. Tel: Basingstoke 1070

Full details are contained in our illustrated catalogue **'ROLADOR STEEL ROLLING SHUTTERS'** *a copy of which will be forwarded on request.*



ASSOCIATED ELECTRICAL INDUSTRIES LIMITED
HEAVY PLANT DIVISION RUGBY & MANCHESTER, ENGLAND
A5461

REEVES VARI-SPEED MOTODRIVE



THE MODERN DESIGN FOR

★ INCREASED EFFICIENCY

★ WIDER SPEED VARIATION

★ NEW SPACE ECONOMY

The fresh, compact styling . . . the improved operating performance . . . and the REEVES record of long trouble-free service on installations throughout industry have established the REEVES Motodrive as a preferred unit for variable speed requirements.

The REEVES Vari-Speed Motodrives are complete variable speed power packages designed to give ultimate performance and operating efficiency to applications in every industry. Right Angle Reducer units are also offered with the same rugged construction and simplicity of operation for year-round dependable service.

New combinations of C-face NEMA motor, variable speed case and gear head give great versatility and adaptability to the new REEVES Motodrives. In both the "C" flow (motor and output shaft on the same side of the belt case) and the "Z" flow (motor and output shaft on opposite sides of the belt case), standard assemblies are available to meet virtually every installation space requirement.

Discs are pre-aligned to give automatic belt alignment. A tension spring automatically maintains correct belt tension for smooth power flow and longer belt life. Special cog construction on belt reduces operating temperatures, and combined sure gripping with maximum flexibility. REEVES exclusive patented "close grooving" lubrication of the variable speed disc assemblies virtually eliminates "sticking discs." Lubricant extrudes into fine grooves in the hub bore of the sliding disc, coating the entire sliding contact area. There is no fretting corrosion as there is no metal-to-metal contact.

Single, double or triple stage reducers are available in gear ratios from 1.17 to 195:1. Reducer oil level plug is located to give full splash lubrication without excessive frothing. Double lip shaft oil seal retains oil . . . excludes foreign matter. REEVES exclusive baffle type vent plug provides positive, leak-proof reducer venting. Variable shaft bearings are lubricated by Reliance Metermatic system . . . grease from reservoir automatically feeds to bearings, even when seldom lubricated.

For literature and information write to:—

JAMES DAY (MACHINERY) LTD.

28 MADDOX STREET
REGENT STREET
(Close to Oxford Circus)

IDM ENGINEERING SALES SERVICE

LONDON, W.1
TELEPHONE:
HYDe Park 2430 & 0456

At the top of the cooling tower

Many Power Transmission problems can be solved by using a suitable Wiseman Reduction Gear Unit. Such an example is the type of Unit required to drive Fans at the top of Power Station Cooling Towers. The answer is to use the Wiseman Vertical Type FVWR Worm Reduction Gear Unit which has been specially designed to give positive lubrication to all bearings.

This is the sort of difficult job where Wiseman Engineers can help with the choice of Unit and suggest the best means of installation.

Write now for booklet No. 103 for full range of units

WISEMAN

ALFRED WISEMAN & COMPANY LIMITED
Glover Street, Birmingham 9.
London Office: Carlisle House, 8 Southampton Row, London, W.C.1.

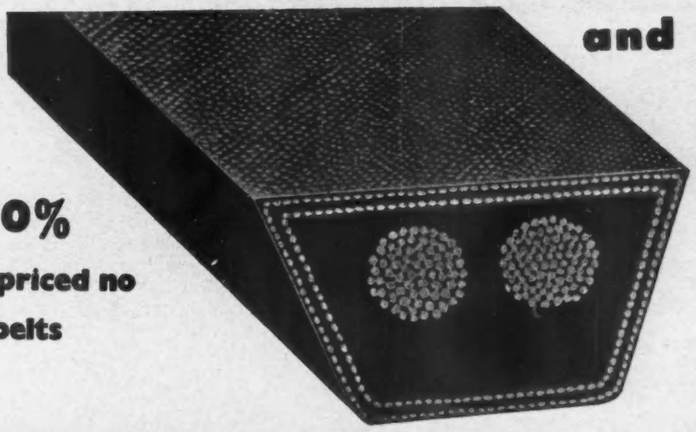
Permanently engraves numbers, data, codes, designs, etc., on metal glass, porcelain, plastics and other hard surfaces —at writing speed with writing ease! Simply plug in to the mains and use. Vibrates at 100 strokes per second on 50-cycle A.C. current. Try out for yourself the tool that Rolls-Royce Ltd. use. Write, wire or 'phone for a VIBRO-TOOL on trial. Discounts for quantities. When ordering please specify voltage.

Write for leaflet I.V.T.2.

BURGESS vibro-tool INDUSTRIAL MODEL

BURGESS PRODUCTS COMPANY LIMITED
Small Tool Division
SAPCOTE, LEICESTERSHIRE Telephone: Sapcote 292

There's a *Big Difference*

between this  and any other V-belt

LAST 20 to 50% LONGER... Yet priced no higher than ordinary belts

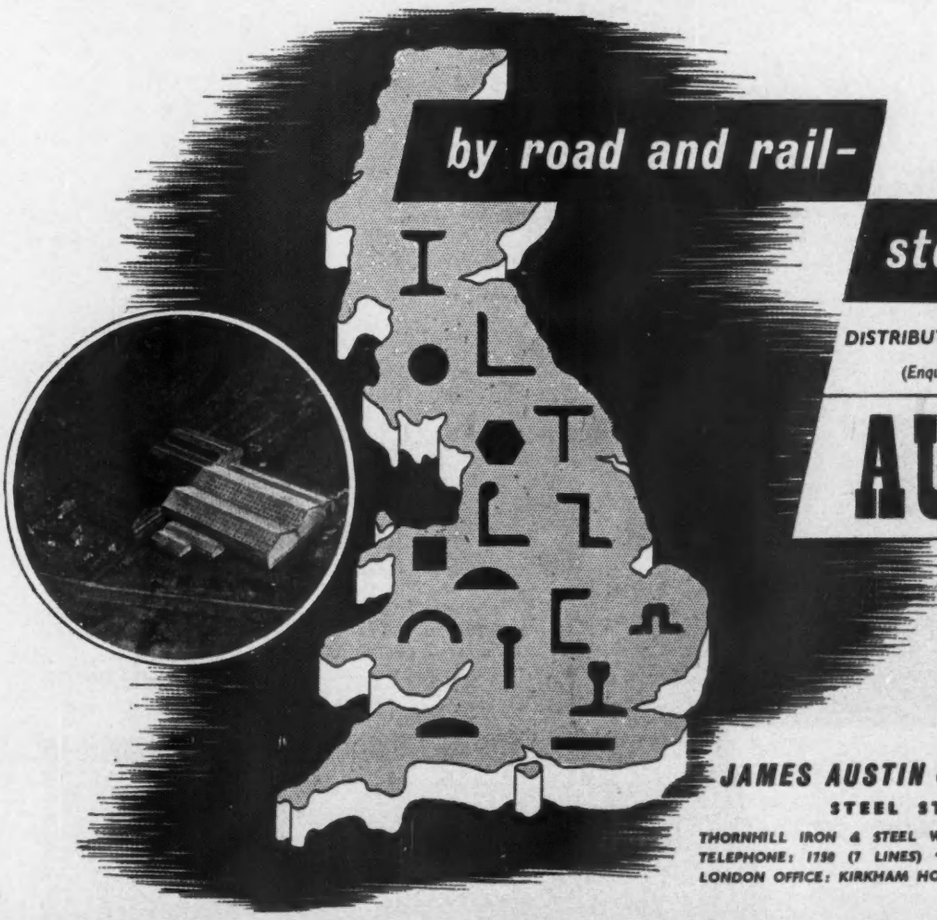
TEXROPE Grommet V-Belts

ALL BRITISH *TEXROPE* GROMMET V-BELT DRIVES MANUFACTURED AND SOLD ONLY BY

FRANK WIGGLESWORTH & CO LTD

SHIPLEY YORKSHIRE

'Phone : SHIPLEY 53141
Grams : CLUTCH, SHIPLEY



DISTRIBUTORS OF ✓ DEXION SLOTTED ANGLES
(Enquiries should be addressed to the Dexion Dept.)

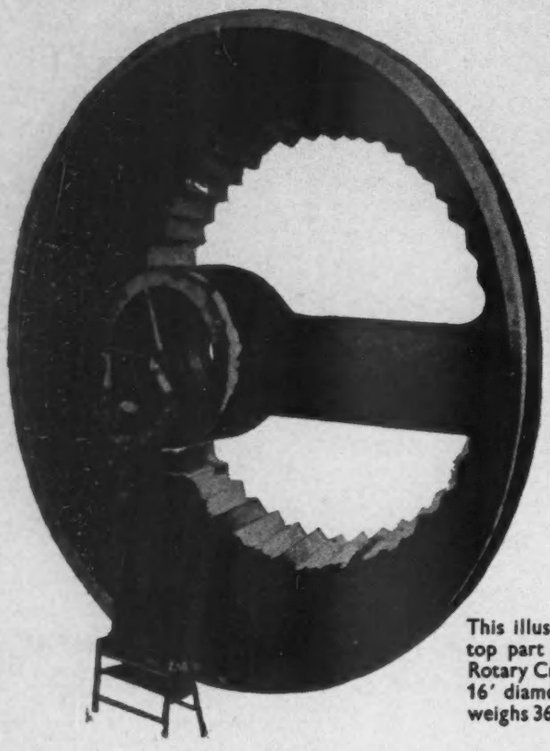
AUSTINS

Make sure you receive our MONTHLY STOCK LIST *by sending your name and the name and address of your Company to* DEPT. S.L.R.

JAMES AUSTIN & SONS (DEWSBURY) LTD.
STEEL STOCKHOLDERS

THORNHILL IRON & STEEL WORKS, DEWSBURY, YORKSHIRE
TELEPHONE: 1750 (7 LINES) · TELEGRAMS: AUSTINS, DEWSBURY · TELEX, No. 55—129
LONDON OFFICE: KIRKHAM HOUSE, 54A, TOTTENHAM COURT ROAD, LONDON W.1
TELEPHONE: MUSEUM 1064

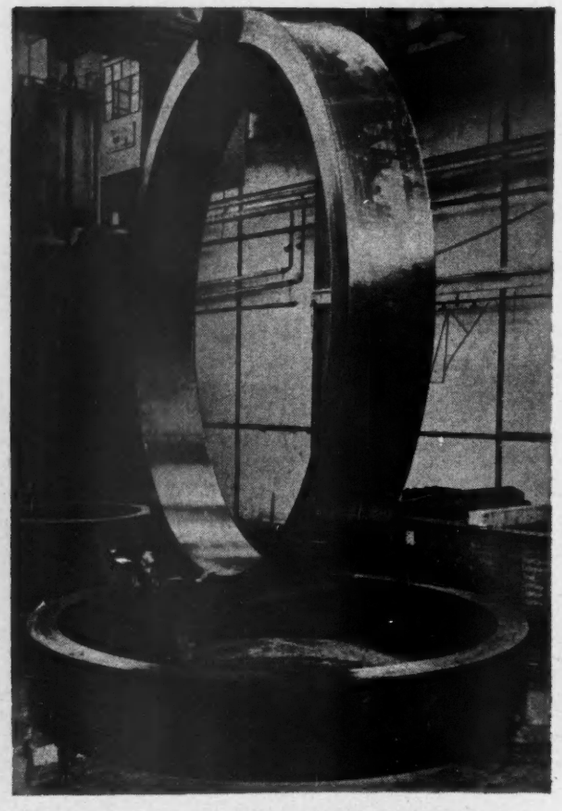
RUHRSTAHL FORGINGS AND STEEL CASTINGS



This illustration shows the top part of the Shell for a Rotary Crusher in cast steel 16′ diameter and 7′ high it weighs 36 tons 3 cwt.

Shown above is a Forged Turbine Shaft of Nickel Chrome Molybdenum special steel rough turned and trepanned. This shaft for a Steam Turbine is 17′ long, the largest diameter 58″ and the smallest 14″, weight 19 tons.

The forged Turbine Shaft shown below in the process of manufacture is made of open hearth steel. The largest diameter is 78″, diameter of flange 68½″ and diameter of shaft 41″. The total length is 41′. Weight finish machined is 47 tons 4 cwt.



The illustration above shows a Cast Steel Tyre 17′ 4″ dia. × 29½″ deep, weight 25 tons. Ruhrstahl also specialise in Rolling Mill Sections for flat rings, angle rings, etc., in a wide range of standard sizes and shapes, full details available on request.

Sole Selling Agents for the British Isles .....

DRUMMOND-ASQUITH LIMITED

Member of the Asquith Machine Tool Corporation

HALIFAX HOUSE, STRAND, LONDON W.C.2.

Telephone Trafalgar 7224

Also at BIRMINGHAM - Phone Midland 3431 and GLASGOW - Phone Central 0922

"No need to resign, Bungleigh!"

"But just look at the mess I'm in! A Knight down, Queen threatened, and my Sicilian Defence in ruins! Can't concentrate, that's my trouble. Not with this cooling water problem on my mind...."

"What's that you say? General Descaling? A **complete** service for the cleaning of every type of pipeline and industrial plant? And I can buy equipment and materials from 'em if I want my own men to do the job? Sounds like the end of my problems—I'll ring first thing to-morrow!"

"And talking about problems, what about B-Q6? There! He thought I'd missed that. Looks as though I'm on to another winner!"

Water, effluents, gas, oil and oil products all flow more easily once G.D. is called in. If you'd like to know more about their services and equipment, write or telephone for the catalogue. And visit stand 537 at the Public Works Exhibition, Olympia, 14-19 November.

General Descaling

the experts in pipeline and sewer maintenance

GENERAL DESCALING COMPANY LIMITED WORKSOP NOTTS.

TELEPHONE: 3211/5 TELEX: 54159

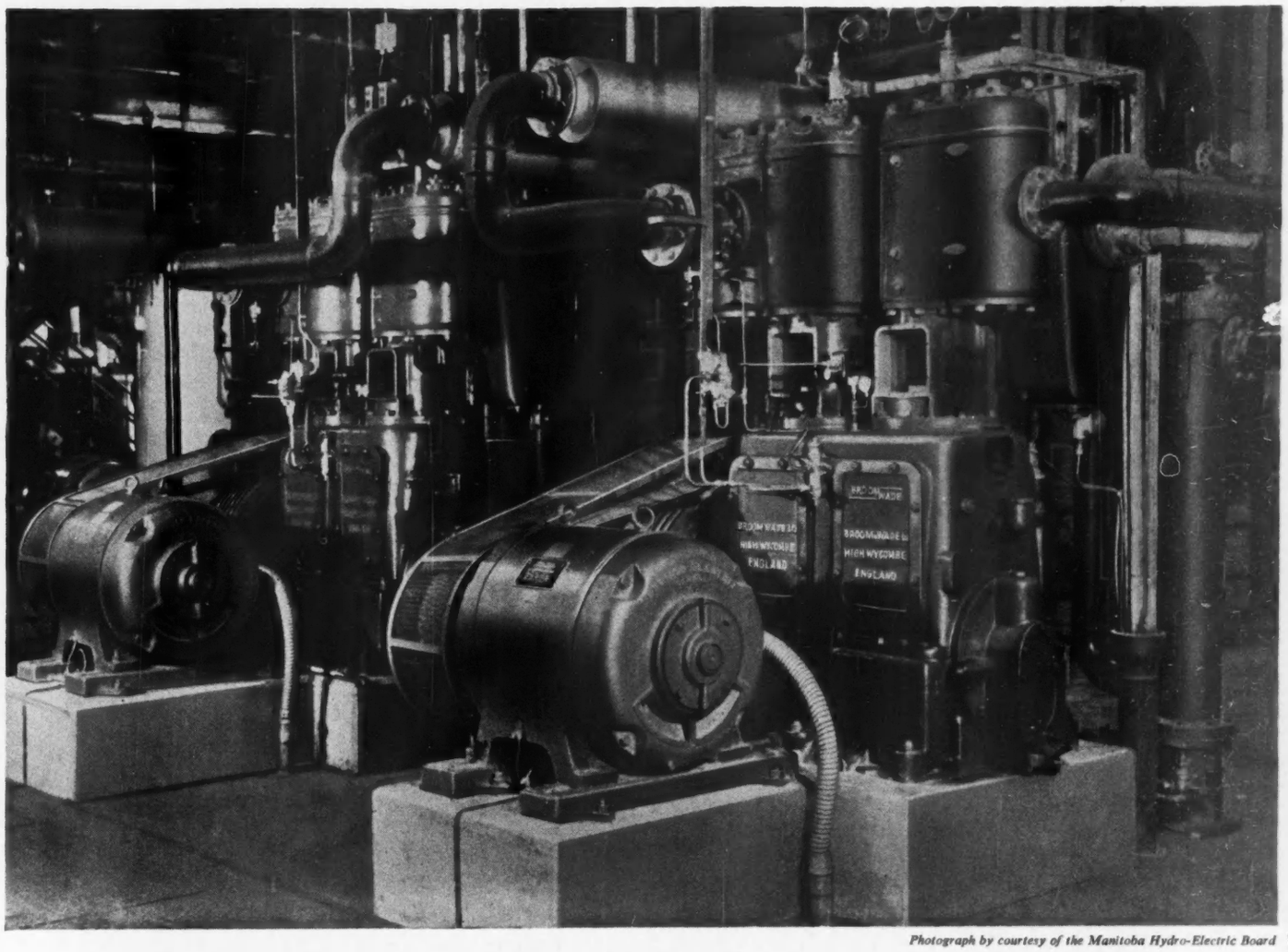
OA/6052A

BP

Distributed by

THE POWER PETROLEUM COMPANY LIMITED

76-86 STRAND · LONDON · W.C.2 *(BRANCHES AND DEPOTS THROUGHOUT THE COUNTRY)*



Photograph by courtesy of the Manitoba Hydro-Electric Board

"BROOMWADE" OIL-FREE compressed air . . . . . at a Canadian Power Station

Among the many "BROOMWADE" installations working in Canada are two Type TS1 Carbon Ring Air Compressors in the Brandon Generating Station of the Manitoba Hydro-Electric Board.

The compressors deliver completely OIL-FREE compressed air for instrument control, the proper functioning of which can be upset by even a minute quantity of oil in the air supply. A constant air supply is essential—"BROOMWADE" compressors provide it.

The choice of "BROOMWADE" equipment for such important duties is yet a further tribute to the ECONOMY, EFFICIENCY and RELIABILITY that have made the name "BROOMWADE" famous all over the world.

MAY WE SEND YOU FULL DETAILS?

"BROOMWADE" manufacture a wide range of air compressors and pneumatic tools covering the requirements of civil and mechanical engineers. A world-wide network of works-trained representatives and qualified maintenance engineers ensures adequate servicing facilities.

"BROOMWADE"

Air Compressors and Pneumatic Tools

YOUR BEST INVESTMENT

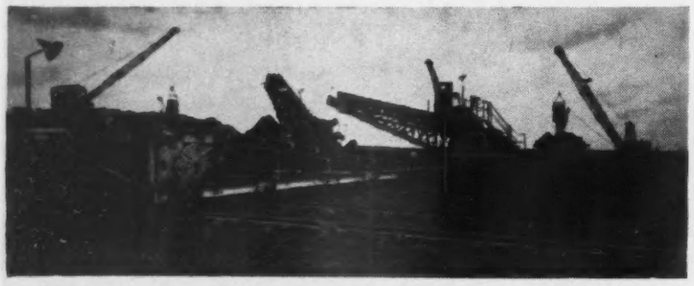
BROOM & WADE LTD., P.O. BOX No. 7, HIGH WYCOMBE, BUCKS, ENGLAND. Telephone: High Wycombe 1630 (10 lines) Telex: 83-127

775 SAS

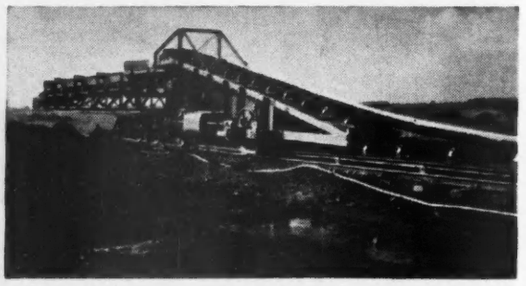
It's never too early to ask Sutcliffes

Sutcliffe conveying equipment has been called to the rescue on many occasions when site conditions have rendered all other forms of mechanical handling ineffective. Muck shifting may not be quite as simple as building sand castles but much time and money can be saved by calling us in at the earliest possible stage.

Please write for our brochure ref. EG 106.



Mobile conveyors on the Great Ouse Flood Protection Scheme.



Tripper and spreader conveyor at Crigglestone Colliery dirt disposal plant.

Sutcliffe

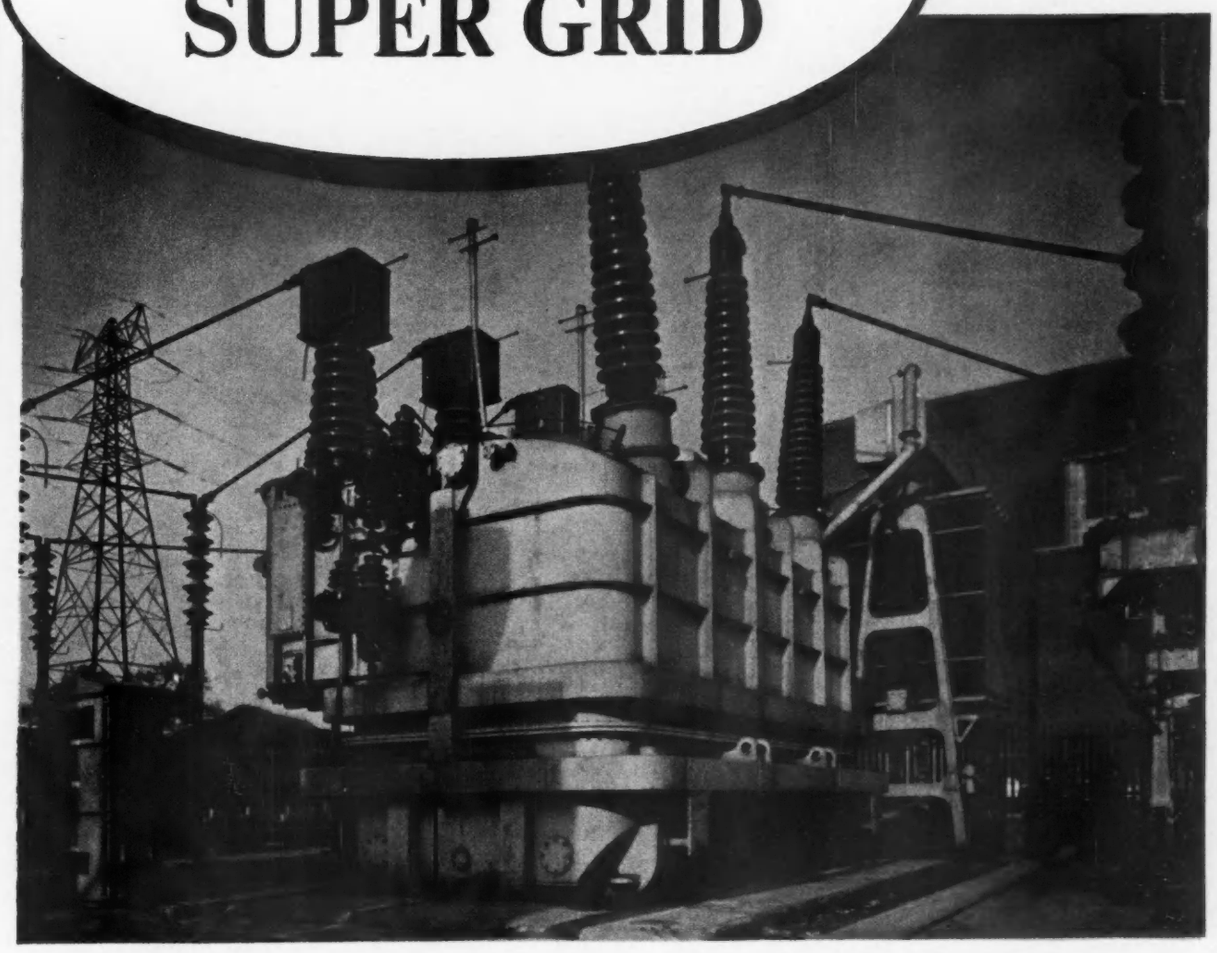
Conveying equipment for hire if required

Britain's Best Conveyors

RICHARD SUTCLIFFE LIMITED • HORBURY • WAKEFIELD • ENGLAND

London Office: 28/29 Savile Row, W.1

GRID linked to SUPER GRID



The first 180 MVA, 3 phase, 132/275 kV auto-transformer to be completed for the Central Electricity Generating Board.

Illustration shows the first of two of these transformers at the Skelton Grange Substation of the Yorkshire Division of the C.E.G.B.

The transformers, each fitted with resistor transition on-load tap changers, were manufactured at the AEI Rugby Transformer Works.

For further details write to AEI Transformer Division, Southmoor Road, Wythenshawe. Manchester 23 or your local AEI office.

AEI

Transformer Division
Manchester and Rugby
Associated Electrical Industries Limited

E/A002

ENGINEERING
26 16 Sept. 1960

SWEDISH LADDER

New drifting technique doubles drill-crew output

Controlled feed · guided collaring · mechanical retraction— so one man can operate two rigs

NORTHERN SWEDEN has been the proving ground of a revolutionary rock drilling method which has opened the way to a completely new conception of drill-crew output. Known as the Swedish Ladder Drilling Method, this new technique has been employed on hydro-electric projects at Korsselbränna and Stalon where drilling platforms with 16 rock drills operated by 8-man drill crews have been used.

Atlas Copco drills mounted on retractable pusher legs* are rested in cradles running horizontally in "ladders". Contractors and drill crews have found that these rigs, cheaply and simply constructed, offer the following advantages:

INCREASED PENETRATION—full feed power is ensured by the ideal horizontal feeding position of the pusher leg.

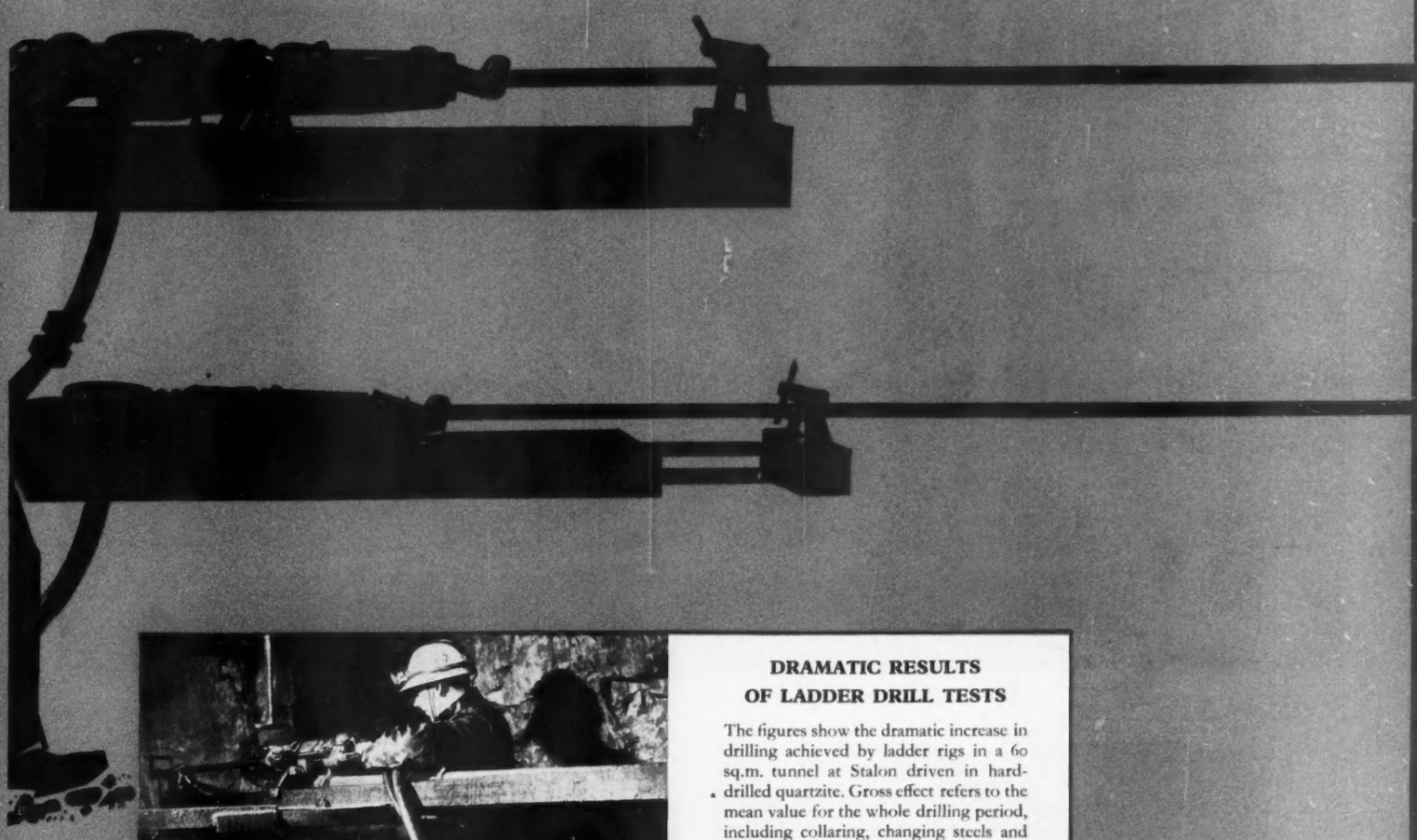
HIGHER OUTPUT PER MAN/HOUR—due to greater penetration and the fact that *one man handles two drills.*

REDUCED CREW FATIGUE—collaring is made simple as operators need not hold the drills. Drill steels are mechanically withdrawn from holes using the retractable pusher leg.

FEWER DRILL STEEL CHANGES—long steels can be used from the start. For greater durability 1″ Sandvik Coromant integral steels are used.

GREATER DRILLING ACCURACY—thanks to the fixed ladder base and pre-positioning of drills for pattern drilling.

DRILLING METHOD



DRAMATIC RESULTS OF LADDER DRILL TESTS

The figures show the dramatic increase in drilling achieved by ladder rigs in a 60 sq.m. tunnel at Stalon driven in hard-drilled quartzite. Gross effect refers to the mean value for the whole drilling period, including collaring, changing steels and the usual routine delays. *Note that the gross effect is exactly doubled.*

GROSS EFFECTS

[redacted]

19.5 metres/man-hour Conventional drilling with *one rock drill.*

[redacted]

39.0 metres/man-hour Ladder drilling with *two drills.*

Available from Atlas Copco. The Swedish Ladder Drilling Method was originally introduced by Widmark and Platzer, one of Sweden's leading contracting companies, and has been further developed by them and by the Swedish State Power Board. Specially evolved with Atlas Copco trigger-operated retractable pusher legs*, this method and equipment has been exhaustively tested and proved under tough Swedish drilling conditions. There are Atlas Copco companies or agents in ninety countries and details of the new equipment are readily available from them or from the address below. Wherever you are, the international Atlas Copco group offers expert advice on the selection of equipment and complete after-sales service.

WRITE FOR THE BOOKLET! The Swedish Ladder Drilling Method is described in greater detail in a new Atlas Copco booklet. Write for a copy to your local Atlas Copco company or agent or from the address below.

* Patents pending

Atlas Copco PUTS COMPRESSED AIR TO WORK FOR THE WORLD

ATLAS COPCO AB, STOCKHOLM 1, SWEDEN

New Melting Shop for English Steel Corporation Ltd., Sheffield.

Steelwork for Industrial Buildings

Illustrated are two recent examples of heavy structural steelwork supplied and erected by ARROL. These form part of a long record of industrial development which can be traced from the ARROL order books

Extension to melting shop of William Beardmore & Co. Ltd. Overhead Electric Crane also supplied by ARROL.

SIR WILLIAM ARROL & CO LTD GLASGOW

Arrol

When vertical transport becomes a serious problem

consult J. & E. Hall

specialists in **Lifts**

and **Escalators**

J & E Hall

LIMITED

DARTFORD KENT

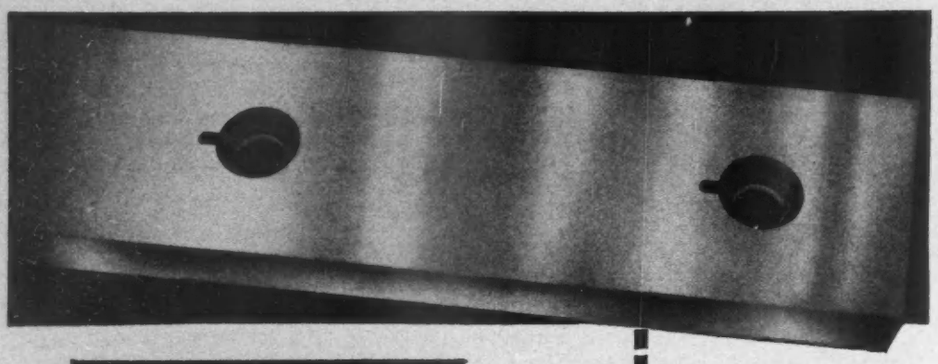
Tel : Dartford 23456

London Office : 10 St. Swithins Lane, E.C.4. MANsion House 9811

Offices and Works throughout Great Britain and Overseas

A member of the Hall-Thermotank Group

d A332



"the blade you can fit and forget"

ZANOGEN SHEAR BLADES

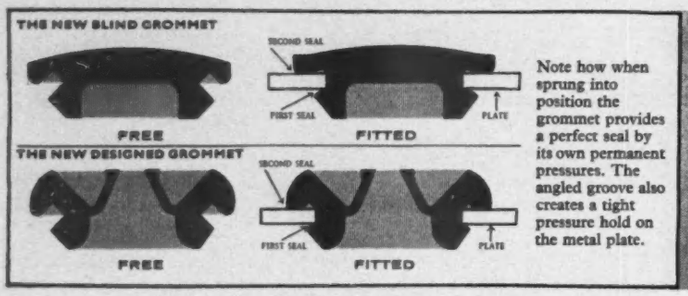
W. FEARNEHOUGH LIMITED

Established 1832

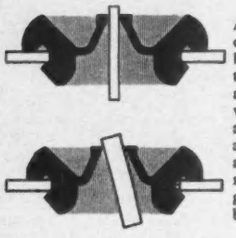
Garden Street, Sheffield 1 Tel: 23247 Telex: Sheffield 54143

THE EMPIRE RUBBER SELF-CONFORMING GROMMET
. . . is the solution to many an engineering problem

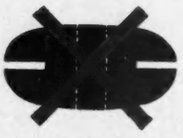
PAT. APP. No. 5255/59



Note how when sprung into position the grommet provides a perfect seal by its own permanent pressures. The angled groove also creates a tight pressure hold on the metal plate.



A useful feature of this cable grommet is that by reason of the designed taper of the cable entry and the flexibility of the web, a considerable angle of cable entry and a variety of cable size, are possible. This avoids necessity for special grommets with angled bores.



In the conventional grommet, only one thickness of plate and only one size of cable can be accommodated. No effective seal is afforded by the parallel groove.

This new development in grommets is now being produced in a range of sizes
These new grommets will solve your sealing problem

Enquire for catalogue and detailed particulars.

EMPIRE RUBBER COMPANY, DUNSTABLE, BEDFORDSHIRE, ENGLAND RB103

DYSON TRAILERS

THE BEST OF HAUL INVESTMENTS

R. A. DYSON & CO., LTD.
LIVERPOOL

BRITAIN'S SMALL NUCLEAR POWER STATIONS

AND

WORLD SURVEY OF REACTOR COMPANIES

Reprinted from 'Engineering' April 15, 22, and May 6, 1960

Price 4s. post paid from 'Engineering' 36 Bedford Street, London WC2

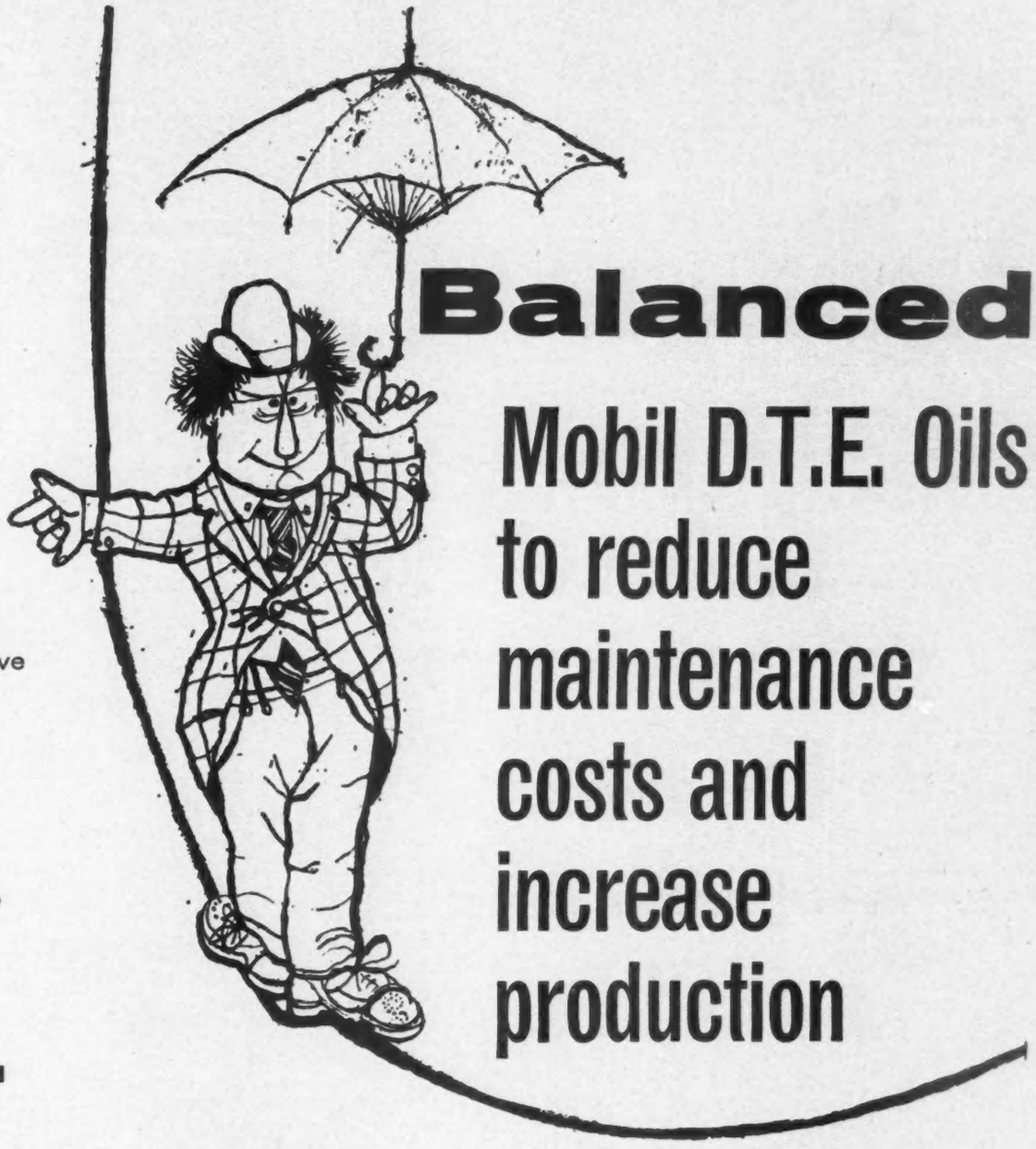
SHEET METAL MACHINERY, MACHINE TOOLS, PRESSES, PLASTICS AND WOODWORKING MACHINES

New and used — many of each EX STOCK — for cash or monthly account, hire purchase or by the F J E Machine Hire Plan.

May we tell you more ?

F. J. Edwards Ltd

EDWARDS HOUSE
359-361 EUSTON RD. LONDON, N.W.1
Phone : EUSton 5000 Telex No. 24264
and Lansdowne House
41 Water St., Birmingham 3
Phone : CENtral 7606-8



Balanced

Mobil D.T.E. Oils to reduce maintenance costs and increase production

Mobil D.T.E. Oils stand head and shoulders above all ordinary oils. They give *balanced* protection and performance that no oil on the market today can equal.

Mobil D.T.E. Oils give you the following advantages:

LONGER OIL LIFE

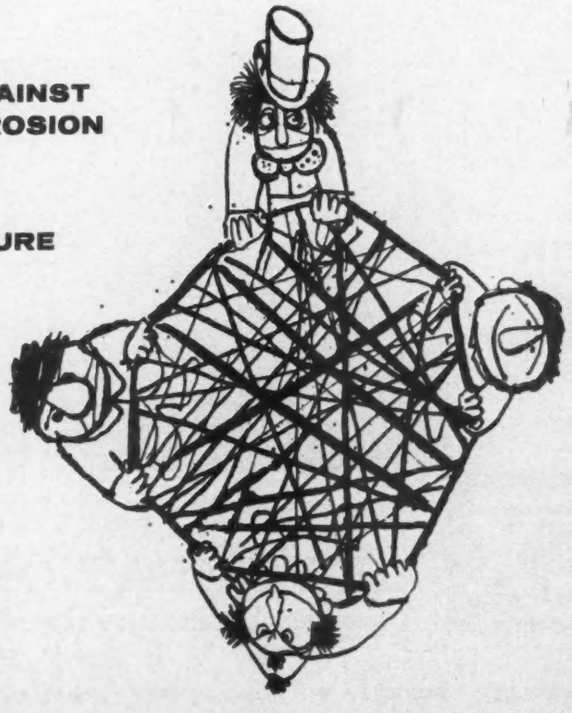
QUICK SEPARATION FROM WATER

FREEDOM FROM DEPOSITS

PROTECTION AGAINST RUST AND CORROSION

LESS WEAR

HIGH TEMPERATURE STABILITY



ASK THE MAN FROM MOBIL ABOUT BALANCED OILS

Our representative will give you the facts—the facts about the performance of Mobil D.T.E. Oils in comparison tests with other well-known hydraulic and circulating oils. Ask the man from Mobil to call and explain how Mobil D.T.E. Oils can reduce maintenance costs and increase production.

Mobil

ECONOMY SERVICE

The NEW "Pyrobit" electrically heated

BRANDING IRON

for the clean, quick, PERMANENT marking of timber, leather, etc.

Operating temperature reached in 10 minutes will take up to 5 one inch letters or numerals.

Letters and numerals easily interchanged.

ACRU ELECTRIC TOOL MFG. CO. LTD.

DEMMINGS ROAD, CHEADLE, CHESHIRE

Telephones: GATLEY 5855 and 6058

GOVAN SHAFTING

AND

ENGINEERING CO.

PROPRIETORS: THE STEEL COMPANY OF SCOTLAND LTD.

BRIGHT DRAWN STEEL TURNED STEEL BARS UP TO 18 in. DIA.

BRIGHT STEEL BLANKS

ANY THICKNESS IN MILD STEEL - FREECUTTING CASE HARDENING - HIGH TENSILE, ETC.

87, HELEN ST., GOVAN, GLASGOW S.W.1

Telegrams: "PEDESTAL GLASGOW." Telephone: Govan 1145 (3 lines)

The meaning of

SMITHS

in Production Planning

FOR IMMEDIATE DELIVERY

An hours counter gives you an exact record of running times of mains powered electric equipment or machinery. This enables you to apply planned maintenance schemes resulting in increased efficiency—and reducing production stoppages. For counting the hours fit a . . .

SMITHS Synchronous Counter

* 10,000 hrs Total Count; 1,000 hrs 'Trip' Count indicating in tenths can be included
* Pressed-steel case to withstand rough handling
* Precision-machined internal gearing for smooth running and self-starting
* High-torque, self-starting, synchronous 2-watt motor available for 50 or 60 cycle supplies of 12, 100/125, 200/250 V

Write now to:-

SMITHS INDUSTRIAL DIVISION

Chronos Works, North Circular Road, London NW2 · Phone: GLA 1136

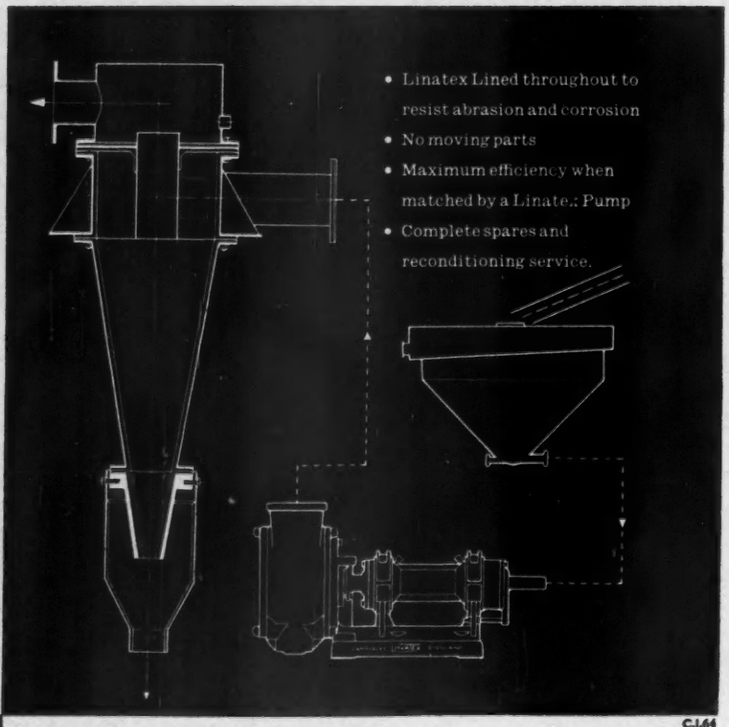
The industrial business of S. Smith & Sons (England) Ltd., including the marketing of industrial products under the trade marks of Smiths and Kelvin Hughes

DISPOSAL OF FINES, DE-WATERING OR THICKENING?

. . . just the job for a LINATEX separation system

Linatex are indeed well qualified to offer this service. It is based on long, world-wide experience of separating and de-watering materials in the sand and mining industries.

Are you thinking of a complete plant? Or do you wish to know how Linatex units can be used in existing installations? Consult our resident area engineer or ask for a proving test on our pilot plant.



- Linatex Lined throughout to resist abrasion and corrosion
- No moving parts
- Maximum efficiency when matched by a Linatex Pump
- Complete spares and reconditioning service.

C.1.64

THE LINATEX ORGANISATION

A WORLD-WIDE SERVICE TO INDUSTRY

WILKINSON RUBBER LINATEX LTD · CAMBERLEY · SURREY · Tel: Camberley 1595 · *Factories and distributors throughout the world*

For highest HEAT TRANSFER efficiency—
SG Gilled Tubing and Heat Exchangers

Heating, cooling, refrigeration—whatever the application, the medium or the conditions, our expert knowledge of heat exchanger design can save you time and money. Besides supplying S.G. gilled tubing in most metals, we make complete heater batteries, coolers, condensers, evaporators, etc., for every branch of industry. We specialise in " specials ", either to your drawings or designed throughout by us to give the figures you require.

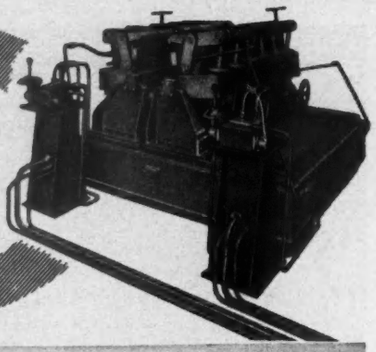
Full facilities available for inspection by Lloyds, Boiler Insurance Companies and Consulting Engineers, to British and American Codes of Inspection.

SG

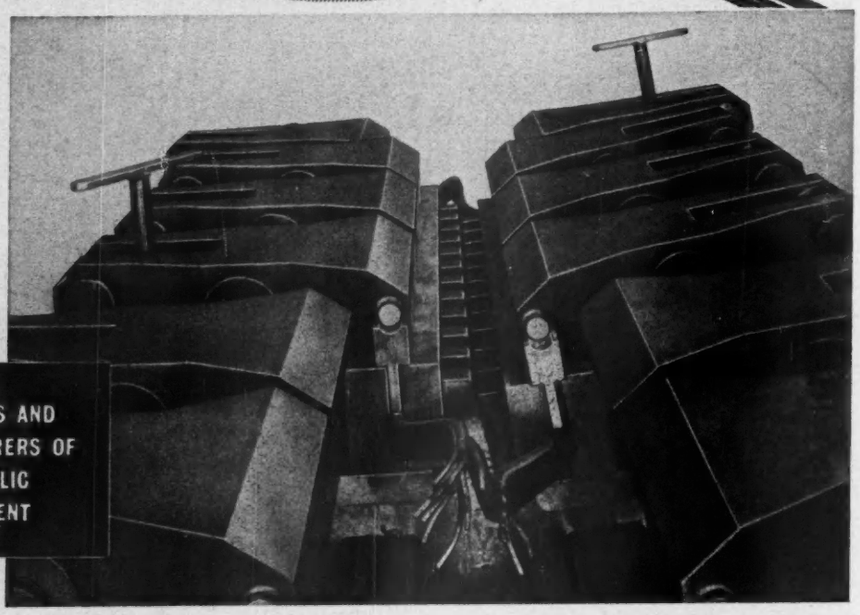
SPIRO-GILLS LTD
London Road, Pulborough,
Sussex *Pulborough 2401/5*

TA2388

COIL PRESS



Specially developed for the electrical industry, the press illustrated is one example of the variety of machines we supply to customers' requirements.



LEH

DESIGNERS AND MANUFACTURERS OF HYDRAULIC EQUIPMENT

THE LEEDS ENGINEERING & HYDRAULIC CO. LTD., RODLEY, LEEDS · Telephone: 'PUDSEY' 2859

L12

ON THE

STOTHERT & PITT

HYDRAULIC TILTING DRUM CONCRETE MIXER

The hydraulic system is safeguarded by the . . .

PUROLATOR FILTER

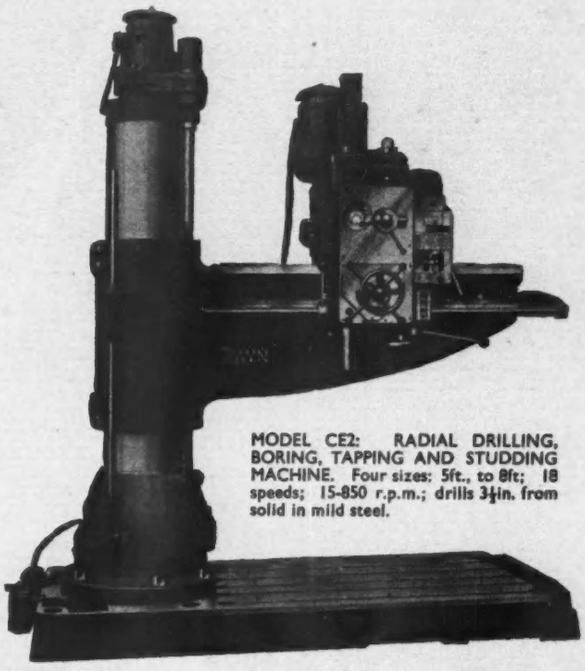
AUTOMOTIVE PRODUCTS COMPANY LTD · LEAMINGTON SPA · WARWICKSHIRE

ONE OF THE AUTOMOTIVE PRODUCTS GROUP

TOWN

DRILLING MACHINES

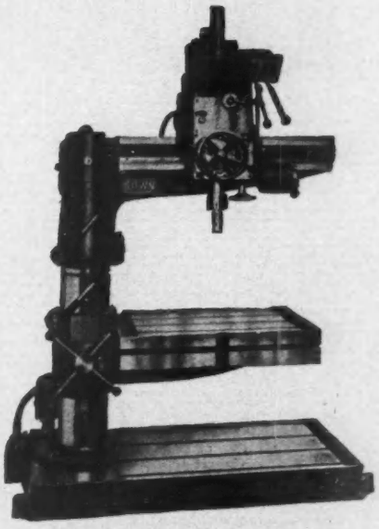
Established over 50 years, the TOWN range of radial and vertical drilling machines is noted throughout the world for modern design, reliability and ease of operation.



MODEL CE2: RADIAL DRILLING, BORING, TAPPING AND STUDDING MACHINE. Four sizes: 5ft., to 8ft; 18 speeds; 15-850 r.p.m.; drills 3¼in. from solid in mild steel.

MODEL AE4: RADIAL DRILLING, BORING, TAPPING and STUDDING MACHINE. Seven sizes: 3ft. 6in., to 8ft.; drills 3in. from solid in mild steel.

MODEL AE2: VERTICAL DRILLING MACHINE (Heavy duty model). Two sizes: 36in. and 42in.; drills 3¼in. from solid in mild steel.



MODEL AE5: RADIAL DRILLING. TAPPING and STUDDING MACHINE. 42in.; drills 1½in. from solid in mild steel or 1¾in. in cast iron.

MODELS EG4 and EG8 RADIAL DRILLING MACHINES. Each model in five sizes: 4ft., to 8ft.; 4 speeds; 160-600 r.p.m. (EG4), 8 speeds; 20-500 r.p.m. (EG8); drills up to 2in. from solid in mild steel. Also made with single speed.

OTHER MACHINES IN THE RANGE

are detailed in a folder 'GO TO TOWN' which is available on request. Variations on the standard range can be undertaken, and examples are also illustrated in the folder.

FRED^K TOWN & SONS LTD | **HALIFAX · YORKS**

ESTABLISHED · 1903

PHONE: HALIFAX 60373/4

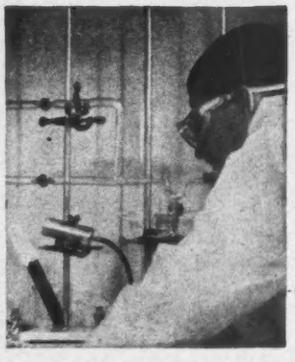
T.12.

nucleol

radiation resistant lubricants for the atomic age

A range developed and perfected by Wakefield-Dick Research

Conventional oils cannot live in conditions of atomic radiation. Such conditions are inseparable from certain parts of any mechanism designed to produce power from nuclear fission. This, and other allied lubrication problems, was the challenge which faced oil [illegible]ologists everywhere. And, as so often in the past, Wakefield-Dick's research team produced the answer. An entirely new series of oils and greases, resistant to radiation and named "Nucleol", is now available to lubricate the wheels of this Atomic Age.



A Wakefield-Dick research chemist investigating the effects of radiation on lubricants.

Two examples of the NUCLEOL range

NUCLEOL 522 A radiation resistant lubricant based on selected mineral oils of high aromaticity and containing special inhibitors.

NUCLEOL G120 A grease gelled with a new compound, and specially inhibited. Designed for the lubrication of control actuator bearings operating at the lower radiation levels.

ENGINEERING Impact

of Mr. Thorneycroft's Visit to Australia

MR. PETER THORNEYCROFT, the Minister of Aviation, by his visit to Australia, where the Woomera rocket range has come to occupy a symbolic place in British space affairs, indicates that a decision on the future of Blue Streak and indeed of an independent space effort by the United Kingdom cannot be much longer delayed.

Much more than national prestige is involved. It is probably true that the British engineers and scientists pursuing their careers without emigrating, despite the fact that they could earn much greater salaries in the United States, are living here because they like it, rather than because they are hopefully awaiting the re-opening of the Blue Streak programme. But a deliberate decision not to get on with launching our own satellites would mean a definite change in the nature of the country in which those scientists and engineers live.

Britain would become a spectator state. It might easily become the reasonable sixth form ambition not only to get to a university but also to emigrate.

Valid arguments on the possibility of ourselves developing communication satellites and producing a profit from space engineering are important in two ways. If orbiting satellite repeater stations prove to be cheaper than submarine cables, despite the need to replace the satellites at intervals, then it is unreasonable to imagine that they will not be used, and sooner rather than later. The United Kingdom is not the only other nation in addition to the United States and the Soviet Union to have done some work on space rockets.

If some other state in the second line of world powers were to get there first it would be hopelessly defeatist for the United Kingdom not to set out to catch up. A depressing prospect if it is remembered that by pressing on now it need never arise.

Jet Engines as Fire Extinguishers

Jet engines may soon be used as fire extinguishers. The latest DSIR report on fire research states that an experimentally modified jet engine has been successfully used to extinguish fires in buildings, by replacing the air with an inert gas.

If the conditions in the building are right, the jet engine can replace the air inside at a very fast rate by an action known as "plug flow." In other words, the inert gas injected by the jet engine acts as a piston which pushes out the air. Tests in a small-scale replica of a large building have shown that this can be done provided the gas is introduced at the right level (a gas lighter than air at ceiling level and vice versa) and that it enters with linear velocity less than a certain critical value.

Of course it would be unreasonable to suppose that these conditions can always be met in fire fighting operations, but it is still possible to render an atmosphere inert by continuously diluting it with inert gas; although the time taken may reach four times as long as with plug flow if conditions are very poor.

The experimental work on this new technique has been carried out at the National Gas Turbine Establishment at Pyestock, Hampshire, where they have mounted the modified jet engine (a comparitively small one) on the chassis of a five ton lorry. This type of vehicle may well become the fire tender of the future, opening up a whole new field of business for jet engine manufacturers as well as presenting a new technique for getting fires under control at high speed.

Dutch Initiative for One Big Europe

The United States motor dealers have almost 900,000 cars of the 1960 styles still on their hands. The export of industrial goods from Denmark is now worth more than her farm produce. And the Dutch have put forward a scheme for a regional association of the European Common Market (The Six) and the British led European Free Trade Association (The Seven).

These developments are by no means unrelated and they bear significantly on the engineering industries of the United Kingdom.

Towards the end of last year and into the first weeks of this year the United States rang with happy predictions for the first of the "Golden Sixties"—forecasts that were rapidly modified, where they were not altogether abandoned. The strike in the American steel mills gave the European industry a chance to sharply increase its exports. It also produced some lively post-strike activity as run-down stocks were replaced.

But now the steel mills run at a disappointingly low level, which means in European terms that the members of the European Coal and Steel Community must look to markets nearer home to maintain and expand their production. Within the prospering members of the European Common Market, rising living standards mop up rising output of household appliances, cars and a whole range of other users of the Continent's steel output. But not the whole of the increasing turnover is sold at home.

Sharply accented competition in British and other domestic appliance markets is partly a sign of the rising industrial activity of Western Germany and Italy in particular. The immense mass production schedules, which the combined markets of France, Germany, Italy and the Benelux states will make possible, will need expanding overseas markets to absorb their full potential. Apart from the United States with its fierce home based competition, Britain, Scandinavia and the rest of Europe offer better prospects than almost anywhere else in the world.

For these reasons, and in their special position across the trading routes of North-West Europe, it was to be expected that the Dutch would introduce their bridge-making scheme at the Stockholm meeting of the Council of Europe's economic committee. Its acceptance there is no guarantee of its final success.

Of greater importance in that direction is the changing pattern revealed in Denmark's trading figures. As industrial exports from that traditionally agricultural economy increase in importance, and as the engineering industries assume growing significance in Norway, Finland and Sweden, so the pressure to make all Europe one big Common Market may become irresistible.

The Dutch proposal to bring about such a development while keeping existing extra-European agreements intact (UK-Commonwealth relations being the largest such group) is close enough to the special provisions of the Treaty of Rome for hopes of agreement to be not unreasonable.

of More People And Growing Appetites

More people demand more food in any language. According to Sir Alexander Fleck there are six ways of getting it—and five of them involve engineers more or less directly.

More nitrogenous fertiliser requires more energy to make it—there is plenty of nitrogen. The Haber Bosch process requires 4 tons of coal per ton of nitrogen or 1½ tons of oil or 60,000 cu. ft of natural gas or 1,700 kWh of electricity. To make urea these figures must be multiplied by about 1¾. It has been estimated that by the end of the century some 60 million tons of nitrogen as fertiliser will be needed every year. At present enough natural gas is being burnt to waste in the Middle East alone to make 5 million tons a year. But the making would be costly in capital outlay.

More water means more power driven pumps and more irrigation works. The Kyle dam in Southern Rhodesia and the Bhakra dams, India, are small beginnings in this task.

Hasten Slowly

More farm machinery is needed. But here thought must be taken to see if it is not a better long term proposition to produce better models of existing types of plough for animal haulage rather than flooding the world with tractors indiscriminately. Apart from the rapid write off of machines handled by local labour, there is a social and human problem here. Slow steps to success are better than quick jumps to disaster. More land under cultivation can call for more heavy machines for the initial break-in but after that a reversion to improved forms of primitive methods may be the best bet.

More efficient use of food supplies makes demands on transport and storage. Burning of surplus wheat and coffee has occurred more than once, yet many were starving at the same time. Moreover the whole of a plant is seldom eaten; much of what is now waste could be used to advantage—though it may be unpalatable in its natural form.

The Antarctic and High Cost Fuel

The Americans are building a nuclear power station at McMurdo Sound in Antarctica. It is a military plant, but may set the pattern for other projects. British small-reactor builders will watch this development with interest, as they have watched the International Atomic Energy Agency's Conference in Vienna on Small and Medium Power Reactors for less developed areas.

The key to success is to find the regions where fuel costs are high. Among the current objectives of the United States civilian reactor programme is the aim to "Assist friendly nations now having high energy costs to achieve competitive levels in about five years." Five years is not long in the development, planning and construction of nuclear power stations.

Admittedly this schedule as applied to Western Europe has been extended during the last two years by the increased availability of fossil fuels and the drop in shipping costs, so break-even should now occur at the same time as in the United States, where the target date for competitive power in high energy-cost areas is 1968. But there are other less fortunate areas than Europe.

High-cost energy areas are considered those regions where fossil fuels now cost 35 United States cents per million Btu, or more. Conventional power costs in these areas are estimated to be about 7 mils per kilowatt hour for a 300 MW(e) single-unit fossil-fuel station using fuel costing 35 cents per million Btu (200 lb per sq. in, 1,050° F or 566° C initial and 1,000° F or 538° C reheat, 1½ in of mercury back pressure) based on 1959 cost levels, no escalation, 80 per cent capacity factor and 14 per cent fixed charges.

and A Shot in the Arm for the Town Hall

From the booming Midlands come reports that the Town Halls, the transport services, the street cleaning departments are increasingly short of men. Quite modest posts in industry easily overtop municipal employment in salaries—and in a factory there are no councillors holding evening committee meetings and expecting some of the staff to be on hand.

When a production line worker in Coventry or Oxford can take home more than a man who has spent twenty years working his way up through the municipal offices it is not surprising that jobs at the bus conductor level stay unfilled.

There is certainly a problem here but it is not as difficult or the situation so gloomy as is currently being made out.

The staff shortages of the town services are a direct reflection of prosperity among the citizens. Taking advantage of that prosperity this is plainly the time for the utmost mechanisation of municipal services. If there are not enough dustmen it would be a simple matter to declare that in future dustbins would only be collected from front gates. There need be no hardship in this for given the demand it would become a marketable proposition to produce sets of wheels on which the dustbins could be trundled to and fro.

As more and more people give up using public transport the driver-conductor one-man bus should take care of the labour shortage there. In the parks and in the street sweeping department there is plenty of scope for powered equipment, and if the cost appears high, so too are the incomes of those who will get the benefit.

And perhaps the Town Halls themselves need reforming. If full time staff are short, and if the status has departed from the job, what an excellent opportunity to re-organise the work so that the bulk of it may be done by part-time women workers.

Insulation for Ultra-Low Temperatures

Liquid oxygen and methane are two substances which place high demands on choice and design of an insulation system. The author discusses both the technicalities and economics involved.

By J. W. Dawson, Stillite Products Limited

PRIOR to the last decade, ultra-low temperatures of −150° F and below were not commonly encountered in large scale industrial plant and processes. The chief exceptions to this were to be found in plant designed for liquifying air and fractionating component gases. Generally speaking, the great bulk of these gases were distributed to consumers in uninsulated pressure vessels and cylinders in relatively small quantities.

In recent years, however, tonnage liquid gas has become relatively commonplace; liquid oxygen, for example, is becoming almost as much a part of the steelmaker's life as refractories have been. Liquid methane and propane are now "bulk" materials in the fuel industry while developments in nuclear engineering have given rise to the use of liquid hydrogen on a large scale.

Basic Requirements

The basic requirements so far as thermal insulation at ultra-low temperatures is concerned remain unchanged, and the most serious difficulty lies in providing and maintaining an effective vapour barrier enclosing the insulation. In cases where there is a negative temperature gradient from the surrounding air to the insulated plant, it is essential to prevent the ingress of air to the insulation compartment or space. If relatively warm air has access to the insulating material it will come into proximity with the cold surface and, there deposit its moisture; the partial vacuum arising from the condensation of water vapour then draws in more air and the cycle is repeated until the insulating material becomes saturated and, therefore, useless.

Apart from the effect of water in increasing the thermal conductivity of insulating materials, it is objectionable for another reason. At ultra-low temperatures many materials are seriously embrittled, and the presence of water accentuates this tendency; most of us are familiar with the effect of liquid air on such objects as tomatoes, rubber and mercury! Embrittlement is only objectionable if the material is likely to be subjected to stresses during use, and in very small scale applications those arising from thermal contraction and expansion are correspondingly small. Materials, therefore, which have given good service in small scale applications in the past are not necessarily suitable for the larger applications of today.

Recognising the importance of low permeability in insulating materials for use at low temperatures, many manufacturers have produced appropriate materials such as foamed Bakelite (Onazote, made by the Expanded Rubber Company), foamed glass (Foamglas, made by Pittsburgh Corning) and foamed polystyrene (Styrocell, made by Shell Chemical Company and Polyzote by Expanded Rubber Company) The pores in these materials are totally enclosed and nearly sealed. Being of a rigid—not to say brittle—nature, these materials lend themselves very well to the application of surface finishes, for although very low permeability provides, so to speak, a "built-on" vapour barrier, there is still the question of sealing joints and insuring against cracks which may develop during lagging operations.

Rigid pre-formed pipe insulating sections applied to extended runs of ultra-low temperature pipework present a difficulty in the form of crushing stresses arising from thermal contraction when the pipe is put to work. Ideally, resilient spacers, disposed between the rigid sections, would take up the contraction and accommodate expansion during periods of shut-down. These spacers, of course, introduce or aggravate the problem of vapour sealing because the only materials available to meet this function are relatively permeable; materials of a rubbery nature are embrittled and so the choice is limited to fibre aggregates such as mineral wool or glass wool.

The effect of a temperature of −296° F on one type of mineral wool—Stillite—can be seen in Fig. 1. The curve shows a comparison of volume stability between identical samples of Stillite 5 lb per cu. ft semi-rigid slab when

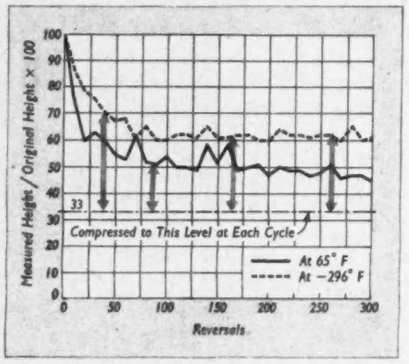


Fig. 1 Mineral wool does not pack so much under repeated compression when at low temperature.

subjected to reversals of pressure—one at atmospheric temperature and the other at −296° F. After each 10 reversals, the sample was allowed to return to equilibrium under the pressure of the plunger type compressor and the new height of the test-piece measured. It will be seen that the low temperature test indicates a higher degree of resilience—and greater consistency than the one carried out at atmospheric temperature. In both cases compression was to 33 per cent of the initial depth, i.e. compression by 67 per cent.

Comparison of Insulants

It will be clear from the foregoing paragraph that mineral wool is very suitable for use as an insulating material at ultra-low temperatures. The table shows a comparison between mineral wool and various other materials in terms of conductivity, etc., at ultra-low temperatures. As indicated, mineral wool is relatively speaking of a spongy consistency and it is usually applied to surfaces in the form of semi-rigid slabs, mattresses enclosed in wire mesh, mats, or pre-formed pipe insulating sections. This is very convenient for practically all types of plant and equipment operating at above zero temperatures because a total insulation thickness up to 6 in will cover almost all types of application except some types of furnace and combustion equipment. These thicknesses can easily be supported by such devices as steel pins or cleats secured to the vessel which it is required to insulate. The thicknesses of insulation applied to plant operating at temperatures below −212° F, however, are very much greater, as a rule, than would be the case with even very high temperature pipework—say, over 1,100° F. Entirely different considerations are involved from those based mainly on the economic value of the heat which it is required to conserve. Thicknesses of 24 in are commonly used at temperatures of −212° F and much greater ones at lower temperatures. Clearly, it would be extremely difficult to attach such thick placings of insulation to the outer surface of a tank or duct.

Double-Skin Construction

The logical outcome of the foregoing is a growing tendency for manufacturers of liquid gas plant and storage tanks to use double-skin construction; that is to say, the unit is enclosed in an outer shell so as to provide a surrounding annulus in which the insulating material can be housed. This system has many advantages including, of course, the elimination of the vapour barrier difficulty. Double skin construction is more expensive and it is important that the cost of the insulating material should be low so as to offset, to some extent, this higher initial outlay. One other important advantage is to be found in the much lower cost of applying suitable insulating materials in the double skin construction. Mineral wool in the loose or flocculent form is very widely used, and this is tamped or rammed into position so as to eliminate, as far as possible, all large voids. This is a somewhat arduous, though not a highly skilled, operation. Spun mineral wools, such as Stillite, are packed to a density of about 12 to 14 lb per cu. ft; this is substantially above the stable packing density claimed by the manufacturers, the increase being due to the desire to eliminate voids—as indicated above. Even better results are claimed for a material described as perlite; this consists of an aggregate of small particles of a glassy nature—each particle having an intricate structure of extremely fine pores—mainly sealed from each other and separated by very thin dividing walls.

It is the very small pores in perlite which contribute largely to its high efficiency as an insulating material; the particles tend to be spheroidal in shape—not an ideal form where low permeability is of great importance because it tends to increase the ratio of interstitial space to pore space. The interstitial spaces are, of course, much larger than the average pore. This is overcome, to a large extent in one grade of perlite called Brelite, made by Expanded Minerals Limited, by providing a very wide range of grading—thereby increasing the packing density to

TABLE:—*Comparison of Insulation Material Properties*

Material and maker	Description (density, lb per cu. ft)	Approximate price per cu. ft	Thermal conductivity Btu/sq. ft.-hr.-deg. F/in (at mean temperature °F)	Maximum safe temperature ° F
Brelite, Expanded Minerals ..	Expanded perlite, loose aggregate (3)	2*s* 0*d*	0·15 (−168)	1,650
Foamglas, Pittsburgh Corning	Foamed glass, rigid slabs (8–10) ..	22*s* 0*d*	0·35 (0)	800
Onazote, Expanded Rubber Co.	Foamed Bakelite, rigid slabs (4) ..	18*s* 0*d*	0·10 (−216)	120
Polyzote, Expanded Rubber Co.	Expanded polystyrene, semi-rigid slab (1)	7*s* 3*d*	0·14 (−126)	140
Santocel A, Monsanto Chemicals	Dehydrated silica gel, loose aggregate (5)	60*s* 0*d*	0·12	750
Stillite, Stillite Products ..	Loose mineral wool..	2*s* 6*d*	0·19 (−168)	1,500

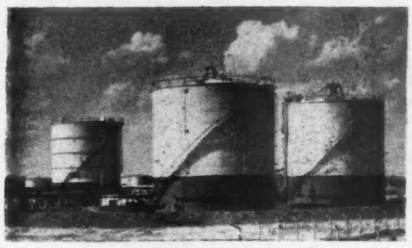


Fig. 2 Liquid methane storage tanks.

approximately 3 lb per cu. ft. Densities as low as 1½ lb per cu. ft can easily be produced, but permeability tends to be high so that conductivity is inclined to be correspondingly high.

Expanded Perlite

Other important advantages of perlite are its relative freedom from moisture pick-up when exposed to humid conditions and its unusually free flowing properties. As a result of this latter feature, application to annuli surrounding liquid gas plant and tanks is extremely simple. The material can be simply poured into its final position from the transport containers, or it can be delivered by pneumatic dispensers. Conveying air speeds have to be maintained at a fairly low level to avoid loss of volume by mutual attrition and impact.

In cases where perlite is used as a loose-fill insulant as described above—particularly in large vessels—precautions have to be taken to ensure that thermal contraction and expansion movements cannot result in damage either to the tank structure or to the insulating material itself. Mineral wool is of a yielding texture and is thus able to accommodate movement of the inner or outer shell. Perlite, however, consists of an aggregate of small particles having a brittle consistency. At maximum packing densities, therefore, contraction of the outer shell and expansion of the inner vessel could lead to crushing of the perlite and ultimately, possibly, to damage of the tank structure. This can be overcome by the use of resilient fibrous insulating material placed in contact with the outer surface of the inner vessel to take up the expansion and contraction. An alternative arrangement involves an ingenious form of construction in which the perlite is contained in a special housing, supported from the outer shell. This provides a space between the inner vessel and the insulation thus relieving the inner tank of any external pressure. Both these systems of insulation were used in the North Thames Gas Board liquid methane storage tanks at Canvey Island.

Difficulties with Mineral Wool for Liquid Oxygen Insulation

For insulation of liquid oxygen vessels there is a difficulty associated with the use of mineral wool. Most grades of this material are treated with a small quantity of oil to improve handling properties and to lay the dust and fine inclusions which are present in some degree. Oil and other carbonaceous inclusions—especially when they occur as a thin film over an extensive surface—are dangerously unstable in the presence of heavy concentrations of oxygen such as might arise from a leak in the holding vessel. It has been found important, therefore, to reduce to the owest practical minimum the inclusions of oil or other carbonaceous matter. In some cases, carbonaceous inclusions as low as 0·1 per cent are specified and the vital consideration is to avoid small local concentrations rather than to rely on a mean value. In order to ensure freedom from local excess concentrations, the additives are treated with a dye which fluoresces under ultra-violet light; by this means, the oil content can be controlled visually. Perlite, of course, is virtually free from carbonaceous inclusions.

Reference has been made in previous paragraphs to the principal applications of thermal insulation to ultra-low temperature plant. Still in the same field—liquid gas—there are special features in the insulation of plant designed to produce nuclear power based on heavy water. It is often desirable and convenient to site such power stations in remote places; indeed, the feasibility of such an arrangement is one of the outstanding advantages of this source of power. Of all materials used in power station construction, perhaps the one which shows the highest ratio of transport cost to

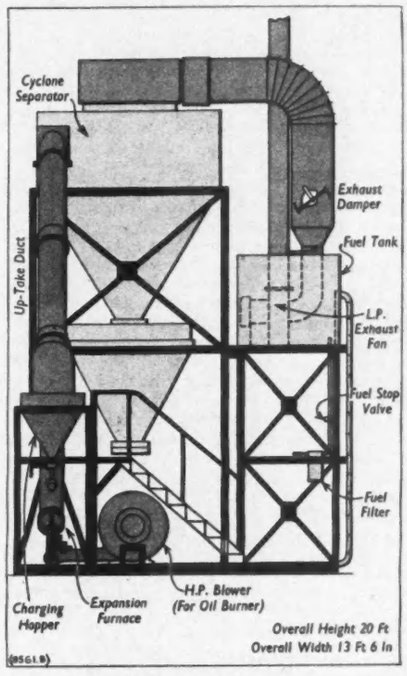


Fig. 3 On site plant for loose-fill perlite made by expanding it in an oil-fired furnace.

value is thermal insulating material. For instance, for a nuclear power station in North Western Pakistan, the ex-Works United Kingdom value of insulation included in a tender was about 40 per cent of the price delivered to the site. It is the great bulk in relation to mass which accounts for disproportionately high carriage charges—whether the journey is of one mile or ten thousand.

In the light of the foregoing, it would clearly be an advantage to manufacture insulating material on site when this is remote from manufacturing centres. The transport of constituent materials is relatively cheap because they are by comparison dense, and do not attract unfavourable rates. For example, perlite in the raw state has a density of about 90 lb per cu. ft—compared with 3 lb per cu. ft in the expanded state. Thus, for a liquid hydrogen vessel requiring 50,000 cu. ft of insulating material, this quantity would only occupy about 1,750 cu. ft in the untreated state; it could, in fact be accommodated in a cube of 12 ft and would weigh about 70 tons.

On-Site Plant for Perlite

Fig. 2 shows the general lay-out in diagrammatic form of a transportable plant developed by Expanded Minerals Limited, for producing perlite. The unit is specially adapted to site operation, using a minimum of labour which can be quickly and easily trained. The mechanics of the expansion process are based upon the occurrence, in the perlite ore, of chemically combined water. When the ore is raised rapidly to a pyroplastic state in the heat exchanger type of furnace, the combined water is evolved as steam which inflates the softened material. The expanded particles or globules tend to be spheroidal in shape; this is the result of a spinning motion imparted by the flame during the transit of the material through the furnace. As indicated above it is possible to reduce the perlite to a density considerably below 3 lb per cu. ft but this may lead to a drop in efficiency. The lighter material also tends to be more fragile.

It will be seen from the foregoing that the developments in large scale thermal insulation of ultra-low temperature industrial plant have led to a reduction in labour costs of lagging at the expense of the cost of over-all construction of plant itself. It has been shown that the much lower cost of insulating materials discussed goes some way towards off-setting this more expensive form of construction. It should be borne in mind, however, that the savings from the particular types of insulation described are not confined to capital cost. With mineral wool, the cost of application is low and skilled labour is not required. Nevertheless, the material has to be tamped or trampled to the specified density; in this operation, presence of oily binders is as beneficial to laggers as to process men in manufature of this material. As indicated, the application costs for perlite are even more favourable.

Powder Vacuum Insulation

Attention was drawn earlier to thickness of insulation considered desirable for ultra-low temperatures. There are a number of instances —such as in long range missiles—where space would not permit the inclusion of such thick insulation without a disastrous loss of pay-load. In these and similar cases increasing use is being made of the technique known as powder vacuum insulation. It is well known that the ideal size of pore in an insulating material would be approximately equal to the mean free path of the enclosed gas at the relevant temperature and pressure. Such materials do not occur in nature, but the properties of perlite and certain other materials (characterised by exceedingly small evenly distributed pores) are such that this principle can be exploited. The pores in perlite are sufficiently close to the ideal to warrant

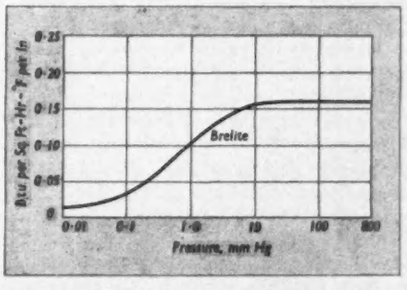


Fig. 4 Powder vacuum insulation. Here, expanded perlite is the "powder" medium.

artificially increasing the mean free path by vacuum pumping. Thus if the space containing expanded perlite is evacuated to a very low pressure, there is a spectacular drop in thermal conductivity; it will be seen from Fig. 3 that the thermal conductivity of Brelite, over the range of temperature 32 to −296° F is reduced from 0·15 Btu per sq. ft-hr-° F per in at 760 mm Hg to 0·012 Btu per sq. ft-hr-° F per in at 0·01 mm Hg—a reduction of more than twelvefold.

It will be seen from Fig. 3 that there is something of a pro-rata advantage at intermediate pressures and there is little doubt that where the magnitude of the plant—or the circumstances —militate against very low pressures, a very worthwhile improvement can be achieved using continuous pumping rather than relying on a positive and permanent seal.

The system described above is particularly suitable for ultra-low temperature applications because of the greater thicknesses of insulation normally used, compared with those for high temperature plant. The technique has already been applied in cases where exceedingly steep temperature gradients are required in equipment for use at above zero temperature.

Plain Words

By Capricorn

OTHER people's snobbery is insufferable. Our own is sacred—or unrecognised. We eschew it or deny it. But I wonder if snobbery is always undesirable. Perhaps these social prejudices may sometimes serve a useful purpose—and, after all, the boundary between snobbery and proper pride is very ill defined. Sir John Wolfenden has drawn attention to a new pattern of conceit, but, unlike him, I think it should be encouraged, not condemned. It is the cult of the white coat.

Once upon a time the white collar was a symbol of prestige, if not of eminence. Now Sir John points a warning finger at the rise of a new symbol. The extension of education, he says, has created a class of people whose Mecca is the laboratory, whose standing in society is measured by their proximity to the high priests of science. He sees a danger in "All that is involved in notions like technocracy . . ."

I can sympathise. He has no doubt read *Brave New World* and other works depicting the growth of science as a dehumanising process. But life isn't like that. The world that science and engineering creates will be inhabited by people, and people have a curious way of humanising whatever world they live in—if only by dropping cigarette ash on the aseptic mass-production artificial-fibre carpet, and buying things from Bognor and putting them on the mantelpiece.

But meanwhile people are starving. People are cold. And there are even people who have to work too hard. Science and engineering still have far to go before they become a nuisance. For the time being we want people who find excitement in the laboratory, the toolroom, and the drawing office.

I tire of people who quote the Soviet Union as a paradise for engineers, but it is true that the Russians have made work into an honourable profession and engineering its most respected contribution. They have done so for one reason. They need technicians. We need them too, and in these days of growing equality in salary and wages, attraction by financial incentives is not so readily applied. The alternative is to make people feel that the jobs they are doing—or rather that the nation wants them to do—are important and worthwhile.

That is, in my view, one of the difficulties in Africa. Colour consciousness has led the abler young Africans to seek jobs with a tradition of prestige—the law, medicine, government—when what these growing nations need are highly trained farmers, craftsmen, technicians and engineers.

They—and to some extent Sir John—are like the old embattled landowner who preferred to see his brightest boy go to the Inns of Court and become a lawyer, able to defend the estate, rather than see the same boy build a factory on the borders of his land, bringing employment to the area, but spoiling the view from the hunting lodge.

Letters to the Editor

Who Pays Development Costs?

SIR, I was very interested in your editorial comment and in the letter you published from Mr. H. Motz on the subject of paying for development (ENGNG., 12 Aug. '60, p. 201 and 26 Aug. '60, p. 268).

I would have thought that for the vast majority of cases, large and small, the simplest and most straightforward answer was that the customer should pay. And, not much less simple, that the customer pays now for future developments, and that the supplier must charge a price which includes the cost of development.

For example, can we not pay now for our expectations of nuclear energy through a direct charge on the price of electricity? This charge would not, of course, be small, but it would be be proportioned more or less as the customer would expect to gain from the improvements brought about by development. The same thought applies to aircraft development. Surely, the passengers' fares now should carry the development charges of supersonic aircraft and the like. This is how things worked out in the past. Individuals and corporations were willing to put money into ventures which they thought profitable, whether these were the Queen Mary, or a pier at Dunoon, or a railway to Stockton. These ventures were, in their day, enormous for the people concerned. Those people were willing to risk their money because they had faith and hope and energy. Is there not the danger that Government grants and subsidies make us unenterprising and perhaps less than careful about the use of the money which comes to us in this fashion?

Government aid is fine for educating the young and feeding and clothing the aged and the infirm. Mr. Motz wishes to spend more money than firms can afford on their earnings from a sluggish home market. I wonder if it is not the firms that are sluggish?

Yours faithfully,
R. A. HUNTER.

58 St. George's Road,
Cullercoats, Northumberland.
9 September, 1960.

A Dirty Job?

SIR, I am afraid Capricorn, whose Plain Words are delightful reading otherwise, missed the point recently (ENGNG., 17 June, '60, p. 808).

The word engineer is derived from engine. On the Continent, however, the word for engineer is *ingenieur*, which is derived from ingenious, meaning quite a different thing. In my opinion that explains a lot about why, in England, the engineering profession is regarded as a dirty one. Maybe Capricorn would elaborate on that some time.

Yours truly,
RAOUL SABLYAK.

3005 W. 20th Avenue,
Vancouver 8, BC, Canada.
5 September, 1960.

Friction Welding

SIR, Your recent article on friction welding (ENGNG., 19 Aug. '60, p. 250) must have aroused considerable interest among many of your readers. This is one of the new developments in welding, and references have appeared in Russian literature since about 1957.

That the Russians regard friction welding as an important development in their technology is evidenced by a recent issue of the monthly Russian journal *Svarochnoe Proizvodstvo* ("Welding Production") for October, 1959, which contains no less than five papers on the subject.

Svarochnoe Proizvodstvo is one of the two Russian monthly welding journals being regularly translated by the British Welding Research Association under the sponsorship of the Department of Scientific and Industrial Research.

Yours faithfully,
E. J. FRENCH.

British Welding Research Association,
Abington Hall,
Cambridge.
26 August, 1960.

Space Engineering

SIR, I think that Mr. R. A. Coffee, in his article "Space Engineering: Britain Must Decide" (ENGNG., 2 Sept. '60, p. 304) has drawn attention to most of the obvious points but there are other, more subtle, aspects which deserve consideration.

At present, space technology has to be considered as providing *potentialities* rather than concrete returns, and to some extent this must always be so, though the number and value of the tangible results may well be so important that space technology might become a major item in every Government Budget within the next decade. We always have this problem of attempting to judge the future in terms of the present. The history of science and technology abounds with remarks by eminent men which have been shown to be complete nonsense very shortly afterwards. One would have thought that the lesson might have been learned by now, but it is not so.

The potentialities of space technology in a direct sense are only just becoming known to us, e.g., the use of satellites for meteorological, astronomical, and communications purposes. We have, as yet, no direct knowledge of the potentialities arising from medical research in conditions of no-gravity, nor metallurgical, chemical or other research in completely new conditions. The feasibility of providing completely new methods of propulsion, adapted only for travel in space but which might provide the means to complete fantastic journeys in short time and at little cost, are only just seeing the light of day. We have, as yet, still the risk of "airy-fairyness" if one dwells on the use of satellites for weather control, and these are only a few of the things which are emerging on the space horizon. Even so, a moment's reflection ought to show that they are all quite sizeable items and that they indicate nothing more or less than a major scientific and technological revolution.

Another aspect of space technology often overlooked is the question of "fringe benefits" which, too, can be very substantial. The construction of space vehicles affects a substantial section of industry in one way or another, and the development of new techniques spreads sooner or later into even more mundane works. Quite a number of fringe benefits can already be ascertained from the present programme, but these are very early days yet and space technology is likely to form a prime part of human activity for the rest of our history.

The British Interplanetary Society is concerned that the United Kingdom should engage on a modest programme of space research, and this includes the construction of suitable launching vehicles. A suggested outline is contained in a Memorandum we have just issued and I shall be pleased to provide copies free of charge to any of your readers who might be interested.

There is, of course, the problem of expense. Space technology is not cheap but there is no reason why it should be. The rewards are substantial and undoubtedly will exceed the expenditure many times over, whatever the cost. A balance has to be drawn between projects of immediate benefit and those of a more long-term nature, but it would be a major error if *all* our resources were concerned with immediate matters with no eye to the future at all. Even so, the amounts to be found are quite sizeable and might best be done by a programme of international cooperation. We are already advocating that both this country and the Commonwealth

(particularly Australia and Canada) should be partners in a West European space effort, and this will be the subject of a symposium we are arranging for 24-26 June, 1961, which will explore this possibility.

Cooperation of this sort may, eventually, have to come about, not only for financial reasons, but also because when men journey to other worlds, they must surely do so as representatives of our planet and not some particular part of it.

Yours faithfully,
L. J. CARTER,
Secretary.

The British Interplanetary Society,
12 Bessborough Gardens,
London, SW1.
7 September, 1960.

Noise Annoyance

SIR, I am afraid that I corrected the galley proof of my British Association lecture (ENGNG., 9 Sept., '60, p. 363) and in so doing introduced an error.

The equation for the total noisiness should read

$$N_T = N_{max} + 0{\cdot}3\,(\Sigma\, N_r - N_{max})$$

or in a better form

$$N_T = 0{\cdot}7\, N_{max} + 0{\cdot}3\, \Sigma\, N_r.$$

Yours sincerely,
E. J. RICHARDS.

The University,
Southampton.
10 September, 1960.

Events in Advance

Water Treatment Europe's First Exhibition

ARRANGEMENTS for what are believed to be the first Effluent and Water Treatment Exhibition and Convention in Europe are now well under way. The two events will run concurrently. It is intended that the exhibition shall be the means of bringing together, in a closer association than on any previous occasion, all parties interested in water treatment: Government departments, local authorities, firms with effluent problems and manufacturers of treatment plant.

Many papers of an outstanding, and possibly controversial, nature are due to be read. Among them may be mentioned "River Pollution Prevention in Scotland," by R. W. Covill; "Pumping," by T. Irvine Hudson; "Problems of Design in Effluent Treatment Plants," by J. W. Oakley; "Coastal Pollution," by J. A. Wakefield; and "Disposal of Radioactive Effluent," by Dr. P. A. L. Northcott.

A great deal of interest in these events is being taken by the Institution of Water Engineers. They are being held at Seymour Hall, London, W1, from 18 to 21 October, 1960, and further details may be obtained from the organisers: Thunderbird Enterprises Limited, 140 Cromwell Road, London, SW7, or by telephoning FREmantle 4063.

Exhibitions and Conferences

Effective Reading, Technical Course on.—Twelve Fridays, commencing 23 Sept., at Ealing Technical College, London, W5. From 8 to 9.30 p.m. Fee £1. Apply to the Head of the Department of General Studies, Ealing Technical College, St. Mary's Road, Ealing, London, W5.

Presentation of Technical Information, Course on—Twelve Fridays, commencing 23 Sept., at Ealing Technical College, London, W5. From 6.30 to 8 p.m. Fee £1. Apply to the Head of the Department of General Studies, Ealing Technical College, St. Mary's Road, Ealing, London, W5.

Technical Sales Activities, Course on.—Commencing Mon., 26 Sept., and lasting for six consecutive weeks (full time) at the College of Advanced Technology, Birmingham. Fee 60 guineas. Apply to Mr. W. J. Williams, Department of Industrial Administration, College of Advanced Technology, Gosta Green, Birmingham 7.

Fuel Efficiency, Seventh Annual Refresher Course on Current Practice in.—Mon., 26 Sept., to Fri., 30 Sept., at Clarendon Laboratory, Oxford. Organised, with the support of the Southern Regional Council for Further Education, by the National Industrial Fuel Efficiency Service, Ailsa House, 181 King's Road, Reading.

Numerical Analysis, Non-Residential Summer School.—Mon., 26 Sept., to Fri., 7 Oct., in Oxford. Aims at teaching elements of numerical analysis in the fields of linear algebra and differential equations to users of automatic digital computers. Apply to the secretary to the Delegacy for Extra-Mural Studies, Rewley House, Wellington Square, Oxford.

Management Decisions, Practical Guide for (Conference on).—Tues., 27 Sept., in London. Organised by the British Institute of Management. Apply to Mrs. J. Hodson, British Institute of Management, 80 Fetter Lane, London, EC4. Tel. HOLborn 3456.

Automatic Control, Symposium.—Tues. and Wed., 27 and 28 Sept., in London. Sponsored by the British Conference on Automation and Computation and arranged by the Institution of Mechanical Engineers. Will study contributions to the First International Congress of the International Federation of Automatic Control (IFAC) held in Moscow from 27 June to 7 July last, especially the 29 papers comprising the British contribution. Apply to the Institution of Mechanical Engineers, 1 Birdcage Walk, London, SW1. Tel. WHItehall 7476.

Electronics and Instruments Exhibition and Convention.—Wed., 28 Sept., to Fri., 30 Sept., at the Farmery Hall, George Street, Hull. Organised by the Institution of Electronics, in cooperation with the Hull Electronic Engineering Society (honorary secretary: Mr. C. W. Wyan, 2 Lockton Grove, Calvert Road, Hull, Yorkshire). Further details are also obtainable from Mr. W. Birtwistle, general secretary, Institution of Electronics, 78 Shaw Road, Rochdale, Lancashire. Tel. Rochdale 48759.

Non-Destructive Testing, Course on Advances in.—Wed. evenings, commencing 28 Sept. (from 7 to 8.30 p.m.), at the Brunel College of Technology. Fee £1. Apply to the Head of the Physics Department, Brunel College of Technology, Woodlands Avenue, Acton, London, W.3.

Birmingham's Steam Evening.—Thurs., 29 Sept., until 9 p.m., at the City Museum and Art Gallery, Birmingham. Various engines will be put on steam and more than 20 railway engine whistles will be sounded. Further details from Mr. N. W. Bertenshaw, Keeper, City Museum and Art Gallery, Department of Science and Industry, Newhall Street, Birmingham 3. Tel. Central 1022.

Radioactivity at Water and Sewage Works, Course of Lectures.—Thurs. and Fri., 29 and 30 Sept., at the Manchester College of Science and Technology. Applications should be made to the Registrar at the College.

Brewing, Bottling and Allied Trades' Exhibition.—Mon., 3 Oct., to Fri., 7 Oct., at Olympia, London, W14. Organisers: Trades, Markets and Exhibitions, Ltd., 623 Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 1371.

Electrification Equipment for British Railways, Exhibition.—Mon., 3 Oct., to Sun., 9 Oct., at Battersea Wharf, near Chelsea Bridge, London, SW8. Organised, in cooperation with the British Transport Commission, by the Locomotive and Allied Manufacturers' Association of Great Britain and the British Electrical and Allied Manufacturers' Association. Will take place at the same time as the British Railways Electrification Conference in London. Apply to the secretary, BEAMA, 36-38 Kingsway, London, WC2. Tel. HOLborn 0502.

Patents and Elementary Patent Practice, Course on.—Tues. and Wed., 4 and 5 Oct., at 3 Belgrave Square, London, SW1. Fee: 5 guineas. Organised by ASLIB, 3 Belgrave Square, London, SW1. Tel. BELgravia 5050.

Accelerator Conference, Second.—Tues., 4 Oct., to Thurs., 6 Oct., in Amsterdam. Organised by the High Voltage Engineering Corporation and their Dutch subsidiary. Apply to the High Voltage Engineering (Europa) N.V. (Post Box 99), 57 Amsterdamseweg, Amersfoort, Netherlands.

Electrons in Aviation and Their Industrial Applications, Convention and Exhibition.—Fri. and Sat., 7 and 8 Oct., at the Bristol School of Science and Technology. Organised by the South Western Section, British Institution of Radio Engineers, c/o the School of Management Studies, Unity Street, Bristol 1. Institution offices: 9 Bedford Square, London, WC1. Tel. MUSeum 1901.

Industrial Staff and Ciné Photographers' Conference.—Mon., 10 Oct., to Wed., 12 Oct., at the Central Hall, Westminster, London, SW1. Organised by the Institute of British Photographers, 38 Bedford Square, London, WC1. Tel. LANgham 1801.

Office Management Conference and Exposition.—Mon., 10 Oct., to Wed., 12 Oct., at the Atlanta Biltmore Hotel, Atlanta, Ga., USA. Organised by the National Office Management Association. Apply to the Field Service Division, NOMA, 1927 Old York Road, Willow Grove, Penn., USA.

Industrial Film and Audio-Visual Exhibition, Fourth Annual.—Mon., 10 Oct., to Thurs., 13 Oct., in New York. Apply to Industrial Exhibitions Incorporated, 17 East 45th Street, New York 17.

Meetings and Papers

British Institution of Radio Engineers

CARDIFF
"A Vidicon Television Camera Channel," by B. S. Pover. South Wales Section. Welsh College of Advanced Technology, Cardiff. Wed., 21 Sept., 6.30 p.m.

Combustion Engineering Association

MANCHESTER
"Modern Fuels and Their Application," by D. C. Gunn. North Western Region. Engineers' Club, Albert Square, Manchester. Tues., 27 Sept., 2.30 p.m.

Institute of Physics and The Physical Society

READING
"Some Developments of the Optical Lever," by Professor R. V. Jones. (This address will be delivered during the conference on diamond physics at Reading, 22 and 23 September.) The J. J. Thomson Physical Laboratory, The University, Reading. Thurs., 22 Sept., 5 p.m. Public lecture: no tickets required.

Institution of Electronics

MANCHESTER
Films on electronic subjects. Reynolds Hall, College of Science and Technology, Manchester. Fri., 30 Sept., 7 p.m.

Institution of Heating and Ventilating Engineers

PRESTON
"Heating in Horticulture," by E. E. Shilman, at 2 p.m., and "Modern Methods of Glasshouse Heating," by L. G. Morris, at 6 p.m. Bull and Royal Hotel, Preston. Tues., 20 Sept.

Institution of Locomotive Engineers

LONDON
Presidential Address, by D. C. Brown. Presentation of awards, by Mr. R. A. Smeddle, immediate past president, for papers read during the 1959-60 session. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Tues., 20 Sept., 5.30 p.m.*

Institution of Mechanical Engineers

CARDIFF
Chairman's Address, by T. G. Dash. South Wales Branch. South Wales Institute of Engineers, Park Place, Cardiff. Tues., 20 Sept., 6 p.m.

Institution of Plant Engineers

LEEDS
"Fuel Economy and Productivity," by K. Higginson. West and East Yorkshire Branch. Houldsworth School of Applied Science, The University, Leeds. Mon., 26 Sept., 7.30 p.m.

LIVERPOOL
"Some Engineering Problems with Chemical Plant," by J. C. Veale. Merseyside and North Wales Branch. Exchange Hotel, Liverpool. Thurs., 22 Sept., 7.15 p.m.

ROCHESTER
"Insulation of Factories and Buildings," by N. Foster. King's Head Hotel, High Street, Rochester. Wed., 21 Sept., 7 p.m.

Society of Instrument Technology

LONDON
"Gas Sampling for Automatic Combustion Control," by R. Hardy; and "Smoke Density Measurement," by G. H. Laycock. Manson House, 26 Portland Place, W1. Tues., 27 Sept., 7 p.m.*

BRISTOL
"Looking at Control Systems with an Analogue Simulator," by S. W. J. Wallis. Bristol Section. Department of Physics, University of Bristol, The Royal Fort, Bristol 8. Tues., 27 Sept., 7.30 p.m.

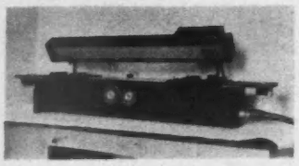
GLASGOW
"Control Equipment for Ship Stabilisers," by J. Bell. Scottish Section. Building Centre, 425 Sauchiehall Street, Glasgow, C2. Fri., 30 Sept., 7.15 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Combustion Engineering Association, 70 Jermyn Street, St. James's, London, SW1. (WHItehall 5536)
Institute of Physics and the Physical Society, 47 Belgrave Square, London, SW1. (BELgravia 6111)
Institution of Electronics, 78 Shaw Road, Thornham, Rochdale, Lancs. (Oldham Main 6661)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Locomotive Engineers, 28 Victoria Street, London, SW1. (ABBey 6672)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)

PINHOLE DETECTOR

For Steel Strip



AN INSTRUMENT has recently been produced for detecting pinholes in steel strip passing continuously.

Basically it consists of a light source and a photocell arrangement between which the strip passes. Any spot of light penetrating the strip is noted by the photocell and indication given. Strip speeds up to 1,700 ft per minute are possible for a hole of 0·005 in effective diameter to be detected. Holes down to 0·002 in can be detected at slower speeds.

The light is mounted in a hinged assembly which can be swung clear of the strip for ease of maintenance. The photocell detection assembly is mounted under the plane of the strip so that a minimum amount of stray light is allowed to reach it.

The light source is a fluorescent tube covering the whole width of the strip. This is supplied with power at 3·5 kc/s from a power oscillator in the control console. The detection head has to be placed as close as possible to the sheet so that all stray light is eliminated. If special care is taken to prevent external light reaching the head, holes down to 0·001 in diameter can consistently be detected. At each edge of the strip are masks mounted on spring loaded slider assemblies to allow for width variations up to $\frac{1}{2}$ in.

The signal due to light passing through the strip is passed to photomultipliers and then to a tuned amplifier, being afterwards used to trigger a pulse generator. The output of the generator is in the form of 80 volt amplitude pulses at a repetition frequency of 400 per second, for the duration of the passage of a fault through the head. A tear in the sheet automatically desensitises the photomultipliers. Standard models are made for strip of width from 27 to 57 in and thickness from 0·006 to 0·029 in. *Bruce Peebles and Company, Limited, Edinburgh, 2.*

NAIL EXTRACTOR

Power Operated

DEVELOPED in Finland, a machine is now on the market in this country for extracting nails from timber.

Speed and simplicity are two of the claims for the Veto machine, which is able to extract 800 nails per hour with minimum damage to the wood. Unskilled labour can be used. Power is supplied by a 1 h.p. geared motor normally intended for 400-440 volt three phase supply. A 24 volt three phase motor can also be fitted for those sites where mains voltage may not be used. This is fed from a transformer.

From the rotary motion of the motor unit, a pair of hardened steel jaws are made to reciprocate vertically. The action of the connecting rod is indirect through a toggle and friction device to close the jaws at the top dead centre and open them at bottom. The closure during the downstroke is power assisted to give a positive grip on the nails. At approximately 1,500 strokes per minute it is possible to draw a nail on alternate strokes. If close enough together more than one can be drawn at a time.

Nails can be withdrawn by the head if more than $\frac{1}{4}$ in is protruding. Normally removal is by the stem pulling the head through the timber. The action is so fast, however, that the hole is scarcely enlarged and splintering of the wood is kept to a minimum. The machine is capable of drawing a $\frac{5}{16}$ in nail through $1\frac{1}{2}$ in timber. *Vauxhall Boiler Company Limited, Bondway House, Bondway, London, SW8.*

DOCUMENT HOLDER

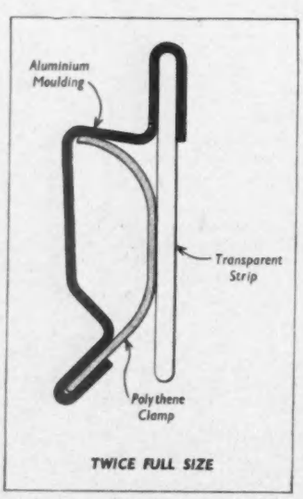
Wall Mounting

DEVELOPED primarily for holding maps, the Pano map rail is a wall mounting fixture giving end to end visibility of any document hung from it. It can also be used for drawings, and charts.

The rail consists basically of an aluminium moulding with two pieces of transparent plastic inserted. The inner member is curved outwards and the outer member is flat and is of a heavier gauge.

Documents to be held are inserted between the two and are automatically gripped in place. The grip is sufficient to hold large maps and the transparent clamping strip allows the whole to be visible not only for the whole length but also for that part held under the clamp itself.

Slotted holes in the moulding fit over wood screws in the wall allowing the rail to be removed if required. The wall is not damaged by drawing pins nor are the documents. If desired, hooks can be clipped along the top edge of the rail from which mounted maps or charts



can be hung. The standard rail of 48 in will hold maps up to 6 ft wide. The depth is approximately $1\frac{1}{4}$ in. *George Philip and Son Limited, 30-32 Fleet Street, London, EC4.*

DUMP TRUCKS

Up to 30 cwt Capacity

THREE new dump trucks have been added to the Roadmac Young Lions series.

The smallest, called the Whelp, has a capacity of 15 cwt; next is the Cub (illustrated) of $22\frac{1}{2}$ cwt and largest is the Lioness of 30 cwt nominal capacity. Low cost is one claim for the trucks.

Attention has been paid to manoeuvrability, and the turning radius of the Cub and Whelp is only 7 ft 9 in; that of the Lioness is 10 ft. The skips of all three have been designed to give instantaneous discharge, both clean and complete, and the loading heights have been kept to a minimum for ease of charging by machine or by hand.

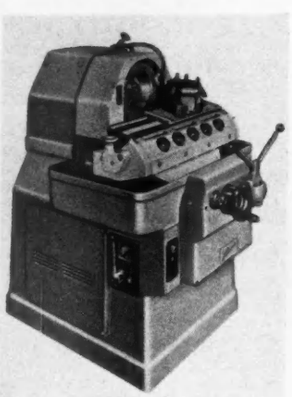
The steering axles are centrally pivoted to give maximum articulation and this, together with the correct weight distribution, ensures maximum traction under all operating conditions whether laden or empty. Each machine has three forward gears and reverse; in each case the third gear gives a maximum speed of 12 m.p.h.

The Whelp has a heaped capacity of 22 cu. ft and struck of 18 cu. ft. Power is supplied by a Petters AVA1 engine developing 6 b.h.p. The Cub has capacities of 27 cu. ft and 22 cu. ft heaped and struck respectively. The engine is a Petters PH1 developing $7\frac{1}{2}$ b.h.p.

The largest, the Lioness has capacities of 36 and 28 cu. ft, heaped and struck respectively, and power is supplied by a Petters AVA2 engine. This develops 12 b.h.p. Special claims include ruggedness, reliability, ease of handling and all-round visibility. *Road Machines (Drayton) Limited, West Drayton, Middlesex.*

TOOL GRINDER

For Lathes and Planers



THE Swiss Scherrer HSM 20-80 lathe and planer tool grinder is now available in this country.

The machine is designed for the rapid grinding of clearance angles on lathe and planer tools up to a cross section of $2\frac{1}{2}$ in square. With additional support, tools up to 3 in by 4 in can be accommodated.

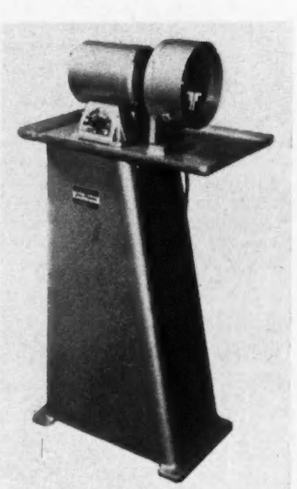
Grinding is performed by six large abrasive segments mounted on the face of a $11\frac{13}{16}$ in diameter cylinder which is driven by its own motor at a speed of 40 ft per second at the periphery. Electrical braking is provided. The table reciprocates at 60 cycles per minute and has automatic timing. Infeeds range from 0·0002 in to 0·0028 in.

It is stated that when grinding both the carbide tip and shank material simultaneously up to 0·135 cu. in per minute can be removed, and up to 3·05 cu. in per minute on high speed steel. The correct grinding angle can be set by means of dials on the machine control panel.

Backing off the clearance of tools reduces the wear on the fine grinding wheels as sharpening can then be carried out several times before the diamond wheel comes into contact with the shank material. *Dowding and Doll Limited, 346 Kensington High Street, London, W14.*

UTILITY HEAD

Polishing, Filing, Reaming or Deburring



A PEDESTAL mounted utility head, Model 1715, can be used in the fitting shop for such operations as polishing, filing, reaming or deburring small parts.

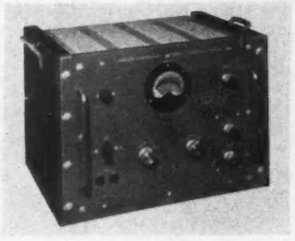
The fabricated column and tray carry a $\frac{1}{2}$ h.p. motor running at 1,420 r.p.m. It is fitted with a Pratt No. 58 5 in diameter 3-jaw self-centring chuck as standard. A guard is provided for covering the chuck sides.

Start and stop of the spindle are operated by a switch built into the base of the motor. Standard supplies are 3 phase 50 cycles at normal line voltages. The chuck bore is $1\frac{1}{4}$ in diameter and $2\frac{1}{8}$ in deep. The height from inside the tray to the spindle centre is $6\frac{1}{8}$ in and the height from the floor, also to the spindle centre, is 38 in.

The floor space required by the machine is 14 in by 22 in and the net weight of the whole equipment is 120 lb approximately. A bench mounting model is also available. The units enable parts to be recovered without returning them to the production machine shop, and thereby disturbing the flow. *A. A. Jones and Shipman Limited, Narborough Road South, Leics.*

MOTOR CONTROLLER

7½ to 7,500 r.p.m.



CONTROL of speed from about 7½ to 7,500 r.p.m. is possible with the MC47 motor controller.

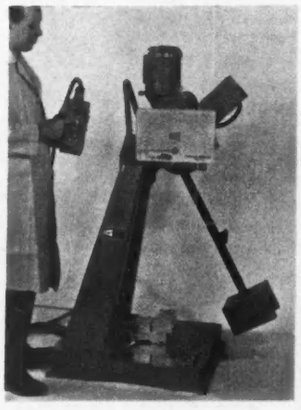
The unit is designed for applications where a wide speed range and high accuracy (to within 0·1 per cent) are required. The motor designed for use with it is rated at ¼ h.p. with a top speed of 7,500 r.p.m., forward or reverse. The actual speed is shown on the meter on the front panel of the instrument. The set speed is maintained regardless of load or supply variations. The efficiency of the unit is high and current is drawn at a leading power factor.

The motor has a high grade linear generator on the shaft which feeds back to the controller. It is basically a constant torque or constant acceleration device, constant speed being obtained by the servo loop. The torque developed is not less than 70 oz-in over the entire range from zero to 7,500 r.p.m. The meter reads correct to 1·5 per cent of full scale. Speed variations of the motor, with the flywheel fitted, are not more than 10 r.p.m. from full load to no load, over the whole range of speeds. Speed drift is not more than 1 or 2 r.p.m. over a period of hours after the motor has warmed up.

The unit normally operates from a single phase supply in the range from 200 to 250 volts 50 cycles. Voltage variations of frequency have no effect on tolerated from the set value, and normal variations of frequency have no effect on the performance. The control unit is linked to the motor by a 12 way cable, and measures 19 in by 14 in by 15 in deep. The motor measure 16½ in long overall, by 5⅛ in diameter. *Servomex Controls Limited, Crowborough, Sussex.*

IMPACT TESTER

Remote Control



SAFETY and speed are provided by a new remote controlled power operated impact tester.

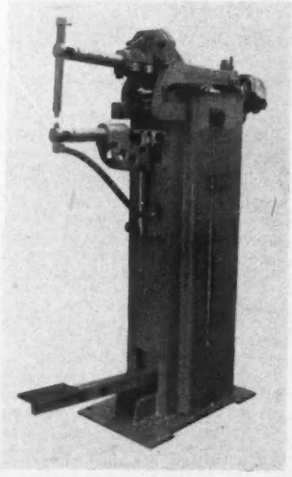
The TMI machine for carrying out tests on standard specimens has an automatic electric safety clutch brake which stops the pendulum after it has made a complete swing. It also has a motorised pendulum return. After the pendulum has been arrested on completion of a test the electric motor and head gear assembly raise the pendulum to its latched position and set it ready for the next test.

The control panel for operating the machine can be located at any distance from it, either for reasons of safety (as when radioactive materials are being tested) or for convenience. If the material is liable to shatter, the machine can be screened from the controller. Further, the physical labour and danger of lifting the pendulum to its starting position is eliminated and the risk of physical injury to the operator removed.

The machine has been proven in use and meets the requirements of ASTM Method E23. It will perform standard Izod, Charpy, and tension impact tests for metals. The power operation speeds up the process by reducing the time between tests. *Testing Machines Incorporated, 72 Jericho Turnpike, Mineola, L.I., N.Y., USA.*

SPOT WELDER

General Light Duties



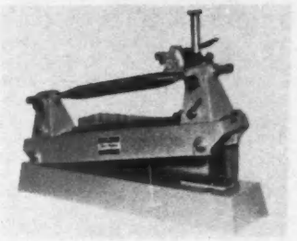
RECENTLY developed is a range of light duty spot welding machines for the smaller workshop.

Two sizes are at present available, rated at 8 and 16 kVA respectively. Two larger air operated models with ratings of 30 and 40 kVA are to follow. The 8 kVA machine is manufactured in two versions, one of which has the lower arm sliding on the pillar to increase the range of adjustment, as shown in the illustration. The lower arm is also reversible. This gives a distance between arms of from 4·5 to 17·9 in. Either 12 in or 18 in long arms can be fitted. Welding capacity is 2 by 14 s.w.g. mild steel.

The 16 kVA machine is also made in two models with different adjustments, the larger giving from 5·7 to 20·6 in between the arms. Arms of 12, 18 or 24 in can be fitted. Its capacity is up to 2 by 11 s.w.g. mild steel. Both machines are intended for 230 or 440 volt supplies and both are operated by a pedal trip type switch. Alternatively weld timers of the non-synchronous type using cold cathode valves can be fitted. *Electro-Mechan Heat Limited, Lower Teddington Road, Kingston-upon-Thames, Surrey.*

SINE CENTRES

20 in Capacity



MODEL 1746 sine centres will accommodate work up to 20 in in length and 9 in diameter.

The radius of the sine bar setting is 25 in giving a guaranteed accuracy over 18 in of 0·0001 in on the dial indicator reading, that is 0·0002 in on the diameter of the work. The base and levelling table are combined on a robust one-piece casting of Meehanite. The levelling table is ribbed and the scraped flat surface includes anti-wringing grooves to facilitate movement of the dial stand. The height of the levelling table above the surface of the slide table aids accuracy. With the dial gauge only a short distance along the stem any error between the stand and the levelling table is reduced to a minimum.

A hardened, ground and lapped slip gauge locating plate is screwed into the base, and the top surface of this plate is exactly 0·2 in below the horizontal of the sine centres to permit even the smallest angles to be measured. Two rubber pads cushion the slide table when it is lowered on the base. The pivot bar is ground and the bracket on the base scraped to prevent float as the slide table is rotated about the pivot bar centre.

The two tailstocks are lapped to accommodate the hardened and ground centres and have a cam locking device for securing them to the slide table. Positive pad bolt locking is provided for the centres which are reversible, male and female. The length of base of the instrument is 32 in and the width 12½ in. Overall height is 12 in. The weight is 190 lb. *A. A. Jones and Shipman Limited, Narborough Road South, Leicester.*

ULTRA VIOLET LAMP

Bench Mounting

AN ULTRA violet bench light, type A409, has been designed around the miniature 9 in ultra violet fluorescent tubes now on the market.

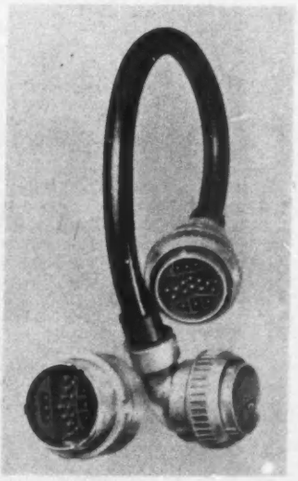
The light source is two 9 in miniature tubes giving radiation in the 3650 Å region. There is no radiation below 3100 Å and also almost no visible light. No warming up period is needed so the unit is instantly ready. High efficiency is claimed, the consumption being 20 watts. The tubes run cool and have an average life of 5,000 hours.

The lamp housing is fully adjustable, including vertical positioning, and the whole unit is stable in any position on the heavy 7 in diameter base. A separate brightened aluminium reflector is fitted to ensure maximum radiation, and a 4 mm Woods glass screen to filter out light in the visible wave band. The light is finished in silver grey hammertone enamel with the stayput tube in polished chrome. It is supplied complete with tubes and cable for use on 200 to 250 volt a.c. mains only.

Uses of the lamp include inspection for engineers, printers, dyers, and in forensic and medical laboratories. Gemmologists and textile manufacturers also require ultra violet light for inspection and colour matching purposes. *P. W. Allen and Company Limited, 253 Liverpool Road, London, N1.*

CONNECTORS

Temperature Range — 55° to + 155° C



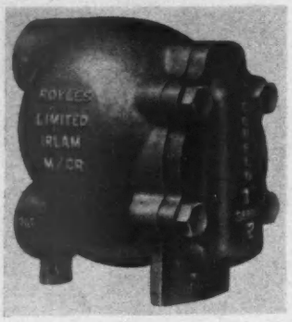
ALUMINIUM connectors Mark 5 can be used in temperatures ranging from — 55° to + 155° C.

Type approval tests have been passed under conditions laid down in DEF 5321, pressure sealing being maintained up to 20 lb per sq. in in the temperature range from —40° C to + 155° C. Operation to lower temperatures is possible where these pressure sealing conditions are not so strictly required.

The units are fully interchangeable with units of the existing Mark 4 type, ratings being 250 volt a.c., up to 60 amperes current with a contact resistance of less than 2 milliohms. The conventional front and rear mouldings are replaced by one-piece mouldings of silicone rubber, specially strengthened, and internal gaskets improve the electrical performance and allow a number of alternative moulding positions. The components are available in four types as free or fixed coupler units, each of which may be a plug or socket. Twelve different contact arrangements are made, with constant loading pressure irrespective of depth of penetration. All contacts are silver plated. *Plessey Company Limited, Ilford, Essex.*

STEAM TRAP

Thermostatic Air Release



LARGER sizes have been added to the Confio range of steam traps, which will operate at pressures up to 200 lb per sq. in.

Existing sizes are ½ and 1 in; the new models are for 1½ and 2 in pipes. The traps are designed to give a continuous flow of condensate and are equipped with a thermostatic release valve. The rate of discharge, within the limits of capacity of the trap, is adjusted to the speed at which the condensate is flowing. All traps are tested hydraulically to 400 lb per sq. in and under steam.

The body is made of high quality cast iron and the cover, also of cast iron, carries the valve and float assembly. A cored passage leads to the outlet connections on the body. The discharge is formed from stainless steel pressings with a renewable stainless steel valve and seat designed to give a high multiplying ratio to the stainless steel ball float. The latter is attached to the moving part of the valve housing.

The thermostatic air release valve is operated by a bimetallic strip to ensure free venting of air when starting up, and the prevention of air locks during running. The whole of the mechanism, which is attached to the cover, may be withdrawn for inspection without removing the body of the trap from the piping. Three valves are made for the Series 2 traps covering pressures up to 25 lb per sq. in; from 25 to 100 lb per sq. in; and from 100 to 200 lb per sq. in. *Royles Limited, Irlam, Manchester.*

FLAME CUTTER

Jointed Arm

NOW being marketed in this country is the Swiss made flame cutting machine illustrated.

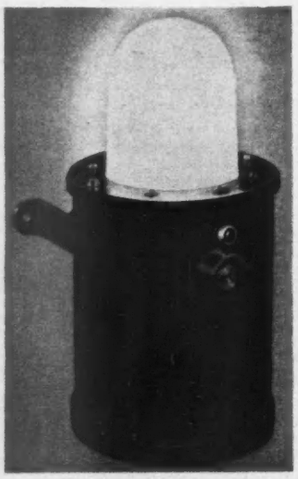
The Rowen-Gloor is designed for use with oxy-acetylene oxy-propane or oxy-coal gas systems. It incorporates four distinct working processes permitting single or batch cuts in mild steel plate from ⅛ in. to 4½ in thick.

Guiding can be done either automatically by a magnetic roller and sheet metal template or manually by a tracing pin and a drawing. The direction of rotation of the magnetic roller can be reversed to follow a template of any shape in either direction and being adjustable vertically it can also follow inner contours. There is a built in device to enable accurate 90° corners to be cut.

Two special features are a parallel guide incorporating locking arms which enables straight line cutting to be made without a template and a compass beam that can be attached to the wheel head for cutting circles. A scale engraved on the beam simplifies size setting. A magnet holds the beam centre in position at any point on the table so that the circle centre can be seated anywhere required. Light in weight, the machine does not require special foundations. *Rowen-Arc (Division of Rubery Owen and Company Limited), Longford Works, Blackhorse Road, Longford, Coventry.*

STANDBY LIGHT

Built-in Charger



THE Moflash is a standby light that comes into operation immediately on mains supply failure.

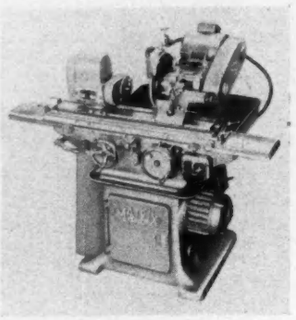
The bulb is rated at 36 watts at 6 volts and the Varley battery included in the case will run it for approximately 1½ hours. Included also in the case is a charger unit run from a transformer and full-wave rectifier with a 6 watt indicating light. The charging rate is 16 hours at 0·75 A.

While the mains supply is on, a relay is held open, but failure of the supply allows the relay to close instantly and switches the battery circuit into operation. A three position switch controls the charging operation, the indicator light showing when charging is taking place. It is claimed that the built-in charger allows a high voltage bulb to be used and reduces battery maintenance.

The lamp unit is arranged for wall or ceiling mounting using the brackets on the case. Overall dimensions are height 11½ in and diameter 6 in. The dome is made of heavy duty crystal standing 5 in high and 4 in diameter. It is available in clear, red or green, to suit requirements. *Silvaflame Company Limited, 218a Monument Road, Birmingham 16.*

CYLINDRICAL GRINDER

24 in Between Centres



THE Matrix 1A-8-24 is a precision cylindrical grinding machine now available with a motorised workhead for live and dead centre work.

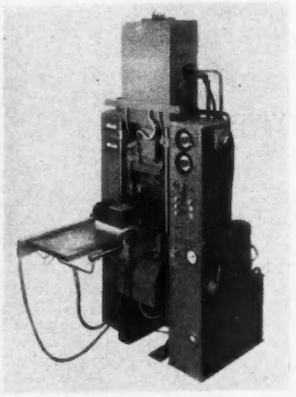
The machine is designed for toolroom and high grade production work and will take up to 24 in between centres and swing 8½ in over the table. The workhead is driven by a ½ h.p. motor and incorporates a gearbox providing six spindle speeds from 60 to 600 r.p.m. The spindle is mounted on taper roller bearings and has a threaded nose for chucks, faceplates, etc. The work head can be swivelled to any angle, the base being accurately graduated in degrees.

The table, which traverses on V and flat ways, is driven by a 1 h.p. motor. Twenty-four table speeds are provided. The upper table swivels up to 20° for taper work. The wheelhead is powered by a 1½ h.p. motor driving through V belts. Three spindle speeds are obtainable by interchangeable pulleys. The standard wheel is 12 in diameter by 1 in wide with a maximum peripheral speed of 6,000 ft per minute. Infeed is by a precision lead screw and nut operated by a hand wheel. A ratchet and pawl mechanism gives fine increments of feed.

The machine can be fitted with a universal wheelhead with a compound swivel and independent top slide movement to enable the wheel to be fed into the work at any angle to the table. *Rockwell Machine Tool Company Limited, Welsh Harp, Edgware Road, London, NW2.*

AUTOMATIC PRESS

20 tons Capacity



AN ADDITION to the Bipel range of automatic moulding presses is a 20 ton machine.

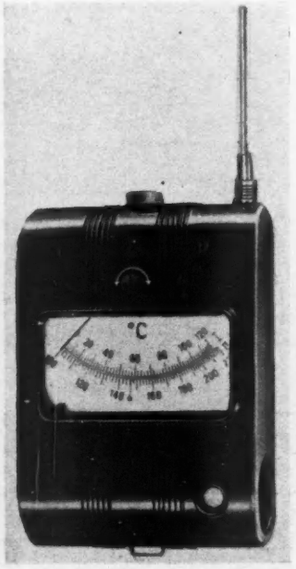
The design has been modified to reduce cycle time and generally simplified. The hydraulic gear is totally enclosed in a cabinet, based on a Vickers vane pump without an intensifier, the pressure being 1,000 lb per sq. in. A hand lever is used to control the ram movement for tool setting, and the slow close valve is remotely controlled by a micro switch. A 1-gallon piston accumulator enables automatic pump unloading to be incorporated and also stores energy for rapid action.

Unlike other Bipel presses, the stripper plate is attached to the front of the loader and both move together. Ejection can be either from the top or bottom, several versions of the former being possible.

The cycle is completely sequenced with the addition of one breadth. This in addition to the slow rise and slow close, is considered to be satisfactory for the type of mouldings likely to be produced on the machine. The length of cure is set by one clock and the breadth by another. Manual or auto cycle can be selected. Heating is electric. Operation is very fast, the open time being 5 seconds. *BIP Engineering Limited, Streetly Works, Sutton Coldfield.*

SURFACE THERMOMETER

Up to 1,112° F



THE Testotherm is a pocket thermometer for measuring surface temperatures up to 1,112° F by direct contact.

The meter is supplied in a leather case for the pocket and has a cord for hanging round the neck. The principle used is that of change of resistance and the sensing head on the probe is a thermistor. It has been developed from a type used for biological and medical purposes.

The instrument is available with a choice of scales, one model ranging from 122° F to 1,112° F on two settings. Another has scales covering the range 32° F to 248° F and from 212° F to 428° F. Several probes are available including a telescopic one that will extend from 10 to 50 in. A special feeler used for highly radiating jackets allows measurements to be taken at a distance of about 4½ yards. The standard model is provided with two feelers one for liquid or gaseous substances and one for powdery or solid materials. *Wingetac Trading Limited, 20 Grosvenor Place, London, SW1.*

Human Element

Foreign Labour in Search of Work and Wages

THERE are more ways than one in which facts, important or inconsequential, may appear. Earlier in the year there was the OEEC report which declared that a common factor in holding back the expansion of production in a number of European industrialised countries would be the shortage of labour, and particularly of skilled men.

Then in the holiday season along the Mediterranean shores German sunbathers, the reputation of their prosperous land flowing with unfilled vacancies having preceded them, found themselves being approached in Italy or Spain by the many local unemployed, hopefully seeking ways of getting into Germany and work. Curiously the same stories do not appear to be circulating in Britain.

In Madrid there is the more or less permanent sight, deeply uncomfortable for the patriotic Spaniard, of several hundred queueing daily outside the office set up by a German immigration service. Over the last four months some 4,000 largely unskilled Spaniards have signed up and left Madrid to work in German factories and on civil construction.

And yet the Spanish are strongly outnumbered by both the Italians and Greeks in the legion of voluntary foreign workers who are sending back to poorer homelands varying proportions of their substantial West German wage packets. A recent count put the number of Italians in the republic at 136,000. There are also some 16,000 Greeks. The Spanish contingent numbers rather more than 13,000.

The labour shortage, despite all this foreign recruitment, continues. Led by the building trades and the group of industries loosely known as metal and engineering, the German employers have put in definite requests for another 30,000 immigrants from the three main sources.

Exploitation

A great deal of attention has been applied to caring for these large numbers of men, most of them concerned to send a high proportion of their wages home, and indeed to return themselves after not too long a time.

If some smaller firms are reported to be backsliders, putting foreign workers into old sheds and generally exploiting their unorganised state, the record of the big companies is said to be excellent, specially provided welfare staff, recreational facilities and attention to established eating habits being not uncommon.

For rather different reasons France too has its influx of workers, many of them from Spain, but also from Belgium as mines regarded as uneconomic are closed down in areas where there is no other work to go to.

Whether sufficient money is being sent home to Spain to generate standards of life on which industry could begin to grow is doubtful. But not more doubtful than the realisation of the hope expressed recently by the Spanish Minister of Commerce, that foreign investment in Spain would remove the need for Spanish workers to emmigrate.

Instructional Turbines for Universities and CATs

Much of the early work done by Charles Parsons, later Sir Charles, on the turbine was carried out at Trinity College, Dublin.

Now one of the Perkins Mars gas-turbine instruction sets being produced at Perkins' Eastfield plant, Peterborough, for colleges of advanced technology (CATs) and universities is to go to Trinity. It will be installed in the Parsons Memorial Laboratories.

The group have received a number of orders for the turbine sets, which are made up of a 50 h.p. Mars gas-turbine fitted with a dynamometer and other special equipment for measuring performance. Starting the good work near at home, the company's first set will be in Peterborough Technical College. Two of the college's lecturers from the mechanical engineering department have attended the course at the Perkins service school.

Old Cars, New Sheds and Well Kept Chickens

Surveying what the British do outside their working hours, Mr. Brian Groombridge, for the National Institute of Adult Education, has reached the somewhat partial conclusion that the subjects of the inquiry are mainly in touch with the outside world through the television set and the car.

Mr. Groombridge's findings, contained in a booklet *Education and Retirement* (8*s* 6*d*) make the important point that all the decorating, gardening, dressmaking and other pursuits of the "domestic culture" of the British tend to be of less significance after retirement. In other words, an important reason for the pursuit of these diverse interests is the contrast they give to the closely regulated working day.

And if this is true, then the subjective approach goes a long way towards explaining why only one in four of Mr. Groombridge's sample population had ever in their lives taken an adult education course. *Education and Retirement* calls for more money, more staff and more accommodation for adult education. There can hardly be any doubt that the opportunity for adult education to contribute to the life of the population at large, and the need for it to do so, will increase.

Shorter hours of work, and for many workers more routine operations, will create hours of leisure which if they are to be filled in building new garden sheds, maintaining the car or re-papering the hall, will benefit from instruction on the best way of obtaining these ends.

Where the money is to come from is not, in this case, merely a way of asking if it should be wrung from the taxpayer. Most of the excellent services of adult education are derisorily cheap. Not because they are cheap to run but because historically they stem from attempts to uplift the once hard-up working classes. No description could now be less apt. Nor are such courses any longer the prerogative of any one class in the community.

The bank manager and the retired major-general are just as likely to be interested in a course in bricklaying as the bricklayer in a course on advanced vehicle maintenance. The extra money needed to extend the services could usefully be raised from those using the courses. There is nothing like having to pay for something for bringing about the desire to use it.

Irritation and Conflict in a Management Course

There is no great difficulty in finding those who believe that many courses on management problems offer a congenial rest for some hard pressed member of the staff and the chance to discuss some of their problems with other staff at similar levels.

There is going to be nothing restful about next month's senior managers course, at the Northampton College of Advanced Technology, London, EC, on the direction and supervision of scientific and engineering personnel.

At a time when there are not enough scientists and engineers to go round anything that can genuinely contribute to the best use of scarce resources of trained manpower is welcome. It is not easy to answer in advance the reasonable question: What can the Northampton CAT course contribute?

The essential requirement is that those running the course, led by Mr. C. A. Leyton, Reader in Communications and organiser of liberal studies, should be aware of the atmosphere and the real human situations in which the problems, themselves easy enough to outline, do in practice arise.

The atmosphere and the situations concern real people, engaged not only in making decisions but in the business of keeping the whole show going. Case histories of particular real-life problems can be a dry artificiality without understanding of the men and women concerned.

Northampton's course is not likely to be short of this sort of knowledge. One of the college's two special lecturers for the course is Mr. Z. M. T. Tarkowski, who wrote a series of articles on the behaviour of people at work in the first half of 1958 for ENGINEERING, which appear in Volume 185 and are still available as a reprint.*

Mr. Tarkowski has drawn up a number of cameos of men in industry who, while they are much more than types, still represent some of the situations of personal tension and difficulty that directly or indirectly occupy a senior manager's attention.

Ambition

The lecturer's fictional Mr. Griffin is a good example. Griffin is an ambitious young man. A graduate fairly new to industry, he was personal assistant to the chairman of the company in his former post and is used to having his readily expressed opinions observed.

Now he is in daily contact with executives, not all of academic qualifications but of considerable experience. His eager expression of opinions naturally causes a certain amount of irritation Highly competent, he becomes despondent if not personally recognised and encouraged

There are sources of irritation, antagonism and conflict in this sort of situation. Interviews, discussions and generally turning over problems with people in them as well drawn as this should mean that the Northampton course, which goes on for 16 full days at intervals of a fortnight beginning on 12 October, will return to their firms a number of managers able to look a little further below the surface.

* *Understanding the Behaviour of People at Work: Introductory Notes for Engineers and Executives* (4*s*, post free, from ENGINEERING, 36 Bedford Street, London, WC2).

Mining Surveyor or Colliery Overman

Whether a man is a technician or a technologist, whether his training has been an education or only the committal to memory of existing laws and established methods—this is not merely playing with words but bears acutely on whether a man is fitted merely for carrying out accepted practices or has the ability to improve and even to conceive new ideas.

Professor E. L. J. Potts and Mr. Kenneth Wardell, both Fellows of the University of Durham, have gone right to the heart of the matter when they suggest, in their recent lecture to the Royal Institution of Chartered Surveyors, in annual conference at Bangor, Wales, that there has been a failure in Britain to produce a mining surveyor of wide enough education and outlook for his status to be generally recognised.

The two authors put their fingers on an undue influence from coal mining on mine surveyors training and education as the cause of the trouble. In a country which has been described as an island of coal it is not particularly odd that there should have been this emphasis. What the authors are saying is that it should have been diff.rently handled.

They assert that the National and Higher National Certificate and the Mining Qualifications Board Examination are at the level of the technician rather than of the technologist.

They would like to see the syllabus of the Institution altered to cover all metalliferous and non-metalliferous mine surveying. Coal mining would then play a significant but not overwhelming part. Equally the Institution's educational policy and programme should be divorced from the Statutory Certificate. This Professor Potts and Mr. Wardell describe as having, in its practical test, complete emphasis on factual knowledge of existing techniques and safety provisions, with only scant reference to "professionalism."

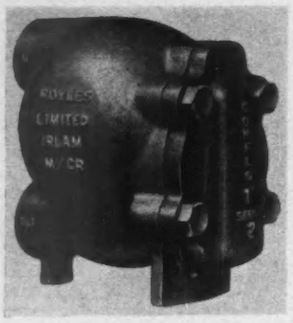
Their forecast for the future, if changes are not made, is gloomy. The profession will continue its gradual loss of status and esteem, both in industry and in relation to other professions, say the authors, if, as in the past 15 years, many more people of minimal ability and ambition are encouraged into mining surveying and are persuaded that the Statutory Certificate is the hallmark of the professional surveyor.

University Chair

Almost in every European country except the United Kingdom mining surveying exists as a profession in its own right. In both Germany and Holland the mine surveyors have the advantage that technical universities maintain chairs in mine surveying. It is common in Europe to find the term mine surveyor applied only to men qualified by prolonged education at a high and recognised level.

STEAM TRAP

Thermostatic Air Release



LARGER sizes have been added to the Conflo range of steam traps, which will operate at pressures up to 200 lb per sq. in.

Existing sizes are ½ and 1 in; the new models are for 1½ and 2 in pipes. The traps are designed to give a continuous flow of condensate and are equipped with a thermostatic release valve. The rate of discharge, within the limits of capacity of the trap, is adjusted to the speed at which the condensate is flowing. All traps are tested hydraulically to 400 lb per sq. in and under steam.

The body is made of high quality cast iron and the cover, also of cast iron, carries the valve and float assembly. A cored passage leads to the outlet connections on the body. The discharge is formed from stainless steel pressings with a renewable stainless steel valve and seat designed to give a high multiplying ratio to the stainless steel ball float. The latter is attached to the moving part of the valve housing.

The thermostatic air release valve is operated by a bimetallic strip to ensure free venting of air when starting up, and the prevention of air locks during running. The whole of the mechanism, which is attached to the cover, may be withdrawn for inspection without removing the body of the trap from the piping. Three valves are made for the Series 2 traps covering pressures up to 25 lb per sq. in; from 25 to 100 lb per sq. in; and from 100 to 200 lb per sq. in. *Royles Limited, Irlam, Manchester.*

FLAME CUTTER

Jointed Arm

NOW being marketed in this country is the Swiss made flame cutting machine illustrated.

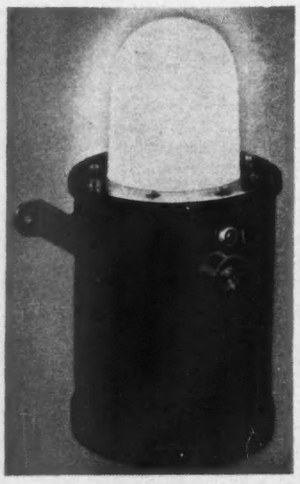
The Rowen-Gloor is designed for use with oxy-acetylene oxy-propane or oxy-coal gas systems. It incorporates four distinct working processes permitting single or batch cuts in mild steel plate from ¼ in. to 4½ in thick.

Guiding can be done either automatically by a magnetic roller and sheet metal template or manually by a tracing pin and a drawing. The direction of rotation of the magnetic roller can be reversed to follow a template of any shape in either direction and being adjustable vertically it can also follow inner contours. There is a built in device to enable accurate 90° corners to be cut.

Two special features are a parallel guide incorporating locking arms which enables straight line cutting to be made without a template and a compass beam that can be attached to the wheel head for cutting circles. A scale engraved on the beam simplifies size setting. A magnet holds the beam centre in position at any point on the table so that the circle centre can be seated anywhere required. Light in weight, the machine does not require special foundations. *Rowen-Arc (Division of Rubery Owen and Company Limited), Longford Works, Blackhorse Road, Longford, Coventry.*

STANDBY LIGHT

Built-in Charger



THE Moflash is a standby light that comes into operation immediately on mains supply failure.

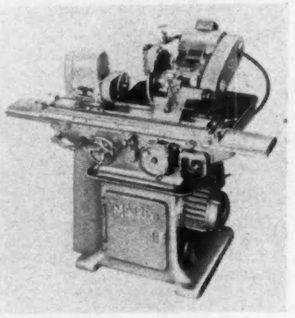
The bulb is rated at 36 watts at 6 volts and the Varley battery included in the case will run it for approximately 1½ hours. Included also in the case is a charger unit run from a transformer and full-wave rectifier with a 6 watt indicating light. The charging rate is 16 hours at 0·75 A.

While the mains supply is on, a relay is held open, but failure of the supply allows the relay to close instantly and switches the battery circuit into operation. A three position switch controls the charging operation, the indicator light showing when charging is taking place. It is claimed that the built-in charger allows a high voltage bulb to be used and reduces battery maintenance.

The lamp unit is arranged for wall or ceiling mounting using the brackets on the case. Overall dimensions are height 11½ in and diameter 6 in. The dome is made of heavy duty crystal standing 5 in high and 4 in diameter. It is available in clear, red or green, to suit requirements. *Silvaflame Company Limited, 218a Monument Road, Birmingham 16.*

CYLINDRICAL GRINDER

24 in Between Centres



THE Matrix 1A-8-24 is a precision cylindrical grinding machine now available with a motorised workhead for live and dead centre work.

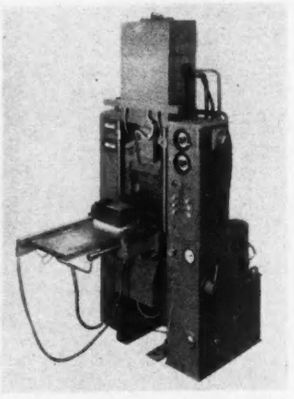
The machine is designed for toolroom and high grade production work and will take up to 24 in between centres and swing 8½ in over the table. The workhead is driven by a ½ h.p. motor and incorporates a gearbox providing six spindle speeds from 60 to 600 r.p.m. The spindle is mounted on taper roller bearings and has a threaded nose for chucks, faceplates, etc. The work head can be swivelled to any angle, the base being accurately graduated in degrees.

The table, which traverses on V and flat ways, is driven by a 1 h.p. motor. Twenty-four table speeds are provided. The upper table swivels up to 20° for taper work. The wheelhead is powered by a 1½ h.p. motor driving through V belts. Three spindle speeds are obtainable by interchangeable pulleys. The standard wheel is 12 in diameter by 1 in wide with a maximum peripheral speed of 6,000 ft per minute. Infeed is by a precision lead screw and nut operated by a hand wheel. A ratchet and pawl mechanism gives fine increments of feed.

The machine can be fitted with a universal wheelhead with a compound swivel and independent top slide movement to enable the wheel to be fed into the work at any angle to the table. *Rockwell Machine Tool Company Limited, Welsh Harp, Edgware Road, London, NW2.*

AUTOMATIC PRESS

20 tons Capacity



AN ADDITION to the Bipel range of automatic moulding presses is a 20 ton machine.

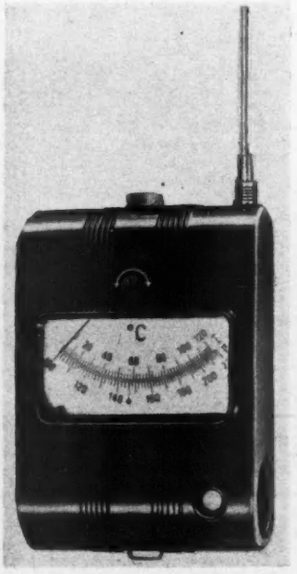
The design has been modified to reduce cycle time and generally simplified. The hydraulic gear is totally enclosed in a cabinet, based on a Vickers vane pump without an intensifier, the pressure being 1,000 lb per sq. in. A hand lever is used to control the ram movement for tool setting, and the slow close valve is remotely controlled by a micro switch. A 1-gallon piston accumulator enables automatic pump unloading to be incorporated and also stores energy for rapid action.

Unlike other Bipel presses, the stripper plate is attached to the front of the loader and both move together. Ejection can be either from the top or bottom, several versions of the former being possible.

The cycle is completely sequenced with the addition of one breadth. This in addition to the slow rise and slow close, is considered to be satisfactory for the type of mouldings likely to be produced on the machine. The length of cure is set by one clock and the breadth by another. Manual or auto cycle can be selected. Heating is electric. Operation is very fast, the open time being 5 seconds. *BIP Engineering Limited, Streetly Works, Sutton Coldfield.*

SURFACE THERMOMETER

Up to 1,112° F



THE Testotherm is a pocket thermometer for measuring surface temperatures up to 1,112° F by direct contact.

The meter is supplied in a leather case for the pocket and has a cord for hanging round the neck. The principle used is that of change of resistance and the sensing head on the probe is a thermistor. It has been developed from a type used for biological and medical purposes.

The instrument is available with a choice of scales, one model ranging from 122° F to 1,112° F on two settings. Another has scales covering the range 32° F to 248° F and from 212° F to 428° F. Several probes are available including a telescopic one that will extend from 10 to 50 in. A special feeler used for highly radiating jackets allows measurements to be taken at a distance of about 4½ yards. The standard model is provided with two feelers one for liquid or gaseous substances and one for powdery or solid materials. *Wingetac Trading Limited, 20 Grosvenor Place, London, SW1.*

Human Element

Foreign Labour in Search of Work and Wages

THERE are more ways than one in which facts, important or inconsequential, may appear. Earlier in the year there was the OEEC report which declared that a common factor in holding back the expansion of production in a number of European industrialised countries would be the shortage of labour, and particularly of skilled men.

Then in the holiday season along the Mediterranean shores German sunbathers, the reputation of their prosperous land flowing with unfilled vacancies having preceded them, found themselves being approached in Italy or Spain by the many local unemployed, hopefully seeking ways of getting into Germany and work. Curiously the same stories do not appear to be circulating in Britain.

In Madrid there is the more or less permanent sight, deeply uncomfortable for the patriotic Spaniard, of several hundred queueing daily outside the office set up by a German immigration service. Over the last four months some 4,000 largely unskilled Spaniards have signed up and left Madrid to work in German factories and on civil construction.

And yet the Spanish are strongly outnumbered by both the Italians and Greeks in the legion of voluntary foreign workers who are sending back to poorer homelands varying proportions of their substantial West German wage packets. A recent count put the number of Italians in the republic at 136,000. There are also some 16,000 Greeks. The Spanish contingent numbers rather more than 13,000.

The labour shortage, despite all this foreign recruitment, continues. Led by the building trades and the group of industries loosely known as metal and engineering, the German employers have put in definite requests for another 30,000 immigrants from the three main sources.

Exploitation

A great deal of attention has been applied to caring for these large numbers of men, most of them concerned to send a high proportion of their wages home, and indeed to return themselves after not too long a time.

If some smaller firms are reported to be backsliders, putting foreign workers into old sheds and generally exploiting their unorganised state, the record of the big companies is said to be excellent, specially provided welfare staff, recreational facilities and attention to established eating habits being not uncommon.

For rather different reasons France too has its influx of workers, many of them from Spain, but also from Belgium as mines regarded as uneconomic are closed down in areas where there is no other work to go to.

Whether sufficient money is being sent home to Spain to generate standards of life on which industry could begin to grow is doubtful. But not more doubtful than the realisation of the hope expressed recently by the Spanish Minister of Commerce, that foreign investment in Spain would remove the need for Spanish workers to emmigrate.

Instructional Turbines for Universities and CATs

Much of the early work done by Charles Parsons, later Sir Charles, on the turbine was carried out at Trinity College, Dublin.

Now one of the Perkins Mars gas-turbine instruction sets being produced at Perkins' Eastfield plant, Peterborough, for colleges of advanced technology (CATs) and universities is to go to Trinity. It will be installed in the Parsons Memorial Laboratories.

The group have received a number of orders for the turbine sets, which are made up of a 50 h.p. Mars gas-turbine fitted with a dynamometer and other special equipment for measuring performance. Starting the good work near at home, the company's first set will be in Peterborough Technical College. Two of the college's lecturers from the mechanical engineering department have attended the course at the Perkins service school.

Old Cars, New Sheds and Well Kept Chickens

Surveying what the British do outside their working hours, Mr. Brian Groombridge, for the National Institute of Adult Education, has reached the somewhat partial conclusion that the subjects of the inquiry are mainly in touch with the outside world through the television set and the car.

Mr. Groombridge's findings, contained in a booklet *Education and Retirement* (8*s* 6*d*) make the important point that all the decorating, gardening, dressmaking and other pursuits of the "domestic culture" of the British tend to be of less significance after retirement. In other words, an important reason for the pursuit of these diverse interests is the contrast they give to the closely regulated working day.

And if this is true, then the subjective approach goes a long way towards explaining why only one in four of Mr. Groombridge's sample population had ever in their lives taken an adult education course. *Education and Retirement* calls for more money, more staff and more accommodation for adult education. There can hardly be any doubt that the opportunity for adult education to contribute to the life of the population at large, and the need for it to do so, will increase.

Shorter hours of work, and for many workers more routine operations, will create hours of leisure which if they are to be filled in building new garden sheds, maintaining the car or re-papering the hall, will benefit from instruction on the best way of obtaining these ends.

Where the money is to come from is not, in this case, merely a way of asking if it should be wrung from the taxpayer. Most of the excellent services of adult education are derisorily cheap. Not because they are cheap to run but because historically they stem from attempts to uplift the once hard-up working classes. No description could now be less apt. Nor are such courses any longer the prerogative of any one class in the community.

The bank manager and the retired major-general are just as likely to be interested in a course in bricklaying as the bricklayer in a course on advanced vehicle maintenance. The extra money needed to extend the services could usefully be raised from those using the courses. There is nothing like having to pay for something for bringing about the desire to use it.

Irritation and Conflict in a Management Course

There is no great difficulty in finding those who believe that many courses on management problems offer a congenial rest for some hard pressed member of the staff and the chance to discuss some of their problems with other staff at similar levels.

There is going to be nothing restful about next month's senior managers course, at the Northampton College of Advanced Technology, London, EC, on the direction and supervision of scientific and engineering personnel.

At a time when there are not enough scientists and engineers to go round anything that can genuinely contribute to the best use of scarce resources of trained manpower is welcome. It is not easy to answer in advance the reasonable question: What can the Northampton CAT course contribute?

The essential requirement is that those running the course, led by Mr. C. A. Leyton, Reader in Communications and organiser of liberal studies, should be aware of the atmosphere and the real human situations in which the problems, themselves easy enough to outline, do in practice arise.

The atmosphere and the situations concern real people, engaged not only in making decisions but in the business of keeping the whole show going. Case histories of particular real-life problems can be a dry artificiality without understanding of the men and women concerned.

Northampton's course is not likely to be short of this sort of knowledge. One of the college's two special lecturers for the course is Mr. Z. M. T. Tarkowski, who wrote a series of articles on the behaviour of people at work in the first half of 1958 for ENGINEERING, which appear in Volume 185 and are still available as a reprint.*

Mr. Tarkowski has drawn up a number of cameos of men in industry who, while they are much more than types, still represent some of the situations of personal tension and difficulty that directly or indirectly occupy a senior manager's attention.

Ambition

The lecturer's fictional Mr. Griffin is a good example. Griffin is an ambitious young man. A graduate fairly new to industry, he was personal assistant to the chairman of the company in his former post and is used to having his readily expressed opinions observed.

Now he is in daily contact with executives, not all of academic qualifications but of considerable experience. His eager expression of opinions naturally causes a certain amount of irritation Highly competent, he becomes despondent if not personally recognised and encouraged

There are sources of irritation, antagonism and conflict in this sort of situation. Interviews, discussions and generally turning over problems with people in them as well drawn as this should mean that the Northampton course, which goes on for 16 full days at intervals of a fortnight beginning on 12 October, will return to their firms a number of managers able to look a little further below the surface.

* *Understanding the Behaviour of People at Work: Introductory Notes for Engineers and Executives* (4*s*, post free, from ENGINEERING, 36 Bedford Street, London, WC2).

Mining Surveyor or Colliery Overman

Whether a man is a technician or a technologist, whether his training has been an education or only the committal to memory of existing laws and established methods—this is not merely playing with words but bears acutely on whether a man is fitted merely for carrying out accepted practices or has the ability to improve and even to conceive new ideas.

Professor E. L. J. Potts and Mr. Kenneth Wardell, both Fellows of the University of Durham, have gone right to the heart of the matter when they suggest, in their recent lecture to the Royal Institution of Chartered Surveyors, in annual conference at Bangor, Wales, that there has been a failure in Britain to produce a mining surveyor of wide enough education and outlook for his status to be generally recognised.

The two authors put their fingers on an undue influence from coal mining on mine surveyors training and education as the cause of the trouble. In a country which has been described as an island of coal it is not particularly odd that there should have been this emphasis. What the authors are saying is that it should have been differently handled.

They assert that the National and Higher National Certificate and the Mining Qualifications Board Examination are at the level of the technician rather than of the technologist.

They would like to see the syllabus of the Institution altered to cover all metalliferous and non-metalliferous mine surveying. Coal mining would then play a significant but not overwhelming part. Equally the Institution's educational policy and programme should be divorced from the Statutory Certificate. This Professor Potts and Mr. Wardell describe as having, in its practical test, complete emphasis on factual knowledge of existing techniques and safety provisions, with only scant reference to "professionalism."

Their forecast for the future, if changes are not made, is gloomy. The profession will continue its gradual loss of status and esteem, both in industry and in relation to other professions, say the authors, if, as in the past 15 years, many more people of minimal ability and ambition are encouraged into mining surveying and are persuaded that the Statutory Certificate is the hallmark of the professional surveyor.

University Chair

Almost in every European country except the United Kingdom mining surveying exists as a profession in its own right. In both Germany and Holland the mine surveyors have the advantage that technical universities maintain chairs in mine surveying. It is common in Europe to find the term mine surveyor applied only to men qualified by prolonged education at a high and recognised level.

Deciding What to Read to Keep Informed

The number of technical journals continues to increase but the time available for reading remains constant. Here is a practical plan which helps the individual to solve this personal problem.

By C. W. Hanson, B.Sc., F.I.Inf.Sc.
Head of Research, Aslib

WHY read technical literature? Is it worth while trying to keep up with it? Some engineers say they are too busy to read the journals. How much are they losing? What penalty, if any, is paid for not reading?

No one at present can give quantitative answers to these last questions, any more than precise answers can be given to the question: how much is research worth? Individual instances of the profitability of research can be given, and instances where the absence of research is associated with stagnation; but the value of research as such has not been measured. Nevertheless, informed people are satisfied that it more than repays its cost.

So it is with technical reading. It is commonly agreed that it is better to have information about other people's progress than to work in ignorance of it, and therefore better to read the literature than to ignore it; and there are sufficient instances of rewards in the form of technical progress or saved money associated with the study of published knowledge to support this view.

In practice the vast majority of engineers do some technical reading. Five surveys of the reading habits of scientists and technologists have yielded figures ranging from two to six hours a week as the average time spent reading published technical material, the median being about five hours a week, or about an hour per working day. These surveys were mostly concerned with people doing research, whose work demands much attention to literature. It included both reading current journals and reading technical literature for specific purposes. Probably few engineers except those engaged in research or academic work would feel justified in spending longer, except on special occasions. The question for them, therefore, is how can they make the best use of up to an hour a day reading time?

Deciding what to read grows increasingly difficult, because while the output of technical literature is growing rapidly, the time available for reading it remains much the same. Modern techniques of fast reading offer some promise of enabling people to read and comprehend a larger number of words in a given time; but choosing the right literature to read must remain the chief factor in ensuring fruitful reading.

A wise selection of reading matter involves some consideration of why one reads. The reason usually given is "to keep up to date." This is true, but not the whole truth. Surveys of reading habits show that people read published technical literature—journals, books, reports, abstracts—

(*a*) to keep knowledge of their own subject up to date,

(*b*) to refresh their memories of what they have learned in the past,

(*c*) to find the specific information needed in connection with their current work and problems,

(*d*) to inform themselves of subjects relevant to their work but outside their own fields of special knowledge.

MENTAL STIMULATION

In addition, perhaps one should add (*e*), mental stimulation, because there is evidence that the main effect, although not the conscious aim, of some reading is mental stimulation rather than the acquisition of immediately useful knowledge. This is probably true of most casual browsing and of some methodical reading of current literature.

Aim (*b*) is normally achieved by returning to text-books familiar in student days. Mental stimulation (*e*) depends so much upon a happy coincidence of author's thought with reader's receptivity that it can hardly be expected to result often from routine reading, although ample reading matter and time to read are essential prerequisites. What can be obtained to a worth-while extent by purposeful reading are awareness of relevant current published information, and the specific information and data required to meet current needs: in short, purposeful reading enables one to keep up to date, and to find what is wanted when it is wanted. Both are possible to an acceptable degree for an individual as well as for an organisation as a whole.

In a large organisation the work of scanning, digesting and searching the literature can of course be shared, and in an organisation furnished with a technical information service and library much of it can be done by information scientists and librarians. But ultimately each engineer holding a responsible position, whether he be the final user of information or an intermediary, must face the question: what shall I, personally, read? This discussion is concerned primarily with the individual, and with small organisations.

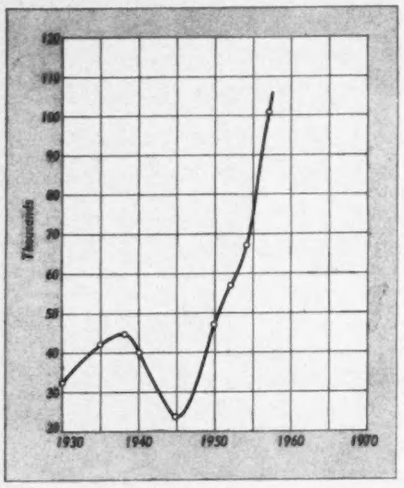


Fig. 1 Numbers of abstracts published in "Chemical Abstracts."

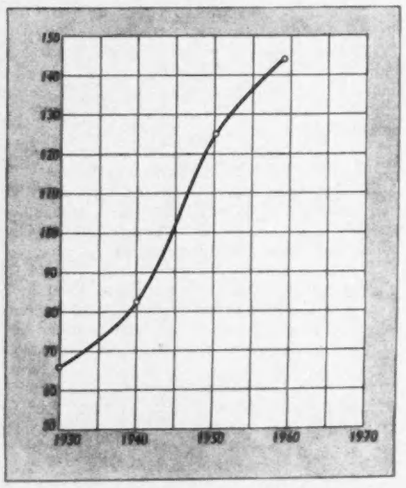


Fig. 2 Growth in the number of United Kingdom journals devoted to engineering.

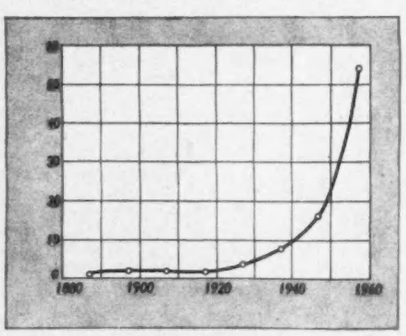


Fig. 3 Growth in the number of journals throughout the world devoted primarily to scientific and industrial instruments.

KEEPING UP TO DATE

The difficulty of keeping up to date with the literature arises mainly from three facts:—

(1) The world output of scientific and technical literature is increasing exponentially. In many branches of technology it is doubling every ten to fifteen years. Even in narrow fields, more is published annually than can be read by one man in the year, unless he devotes his whole time to reading.

(2) All branches of science are to some degree interdependent and interpenetrating. This means that material on one subject, published in the journals and books appropriate to that subject, may be of potential value to a worker in a different subject who would not normally see those publications or expect them to be useful to him.

(3) A growing volume of technical literature is published in languages which few English engineers can read, notably Russian, Japanese and Chinese.

The growth of technical literature, some aspects of which are illustrated in Figs. 1 to 3, cannot continue forever because the whole population of the world cannot devote the whole of its time to writing technical articles; but the present rate of growth may well continue until Asia, Africa and South America are fully developed industrially—some decades at least. The world output grows more rapidly than the UK output.[3, 4, 5]

The need for inter-disciplinary knowledge likewise is likely to increase. Electronics has entered into mechanical engineering, nuclear science into process control, solid state physics into mundane electrical engineering. The human sciences have begun to impinge upon engineering and technology. Psychologists, mathematicians and engineers work together in operational research; and the design, to give one example, of instrument dials is now the concern of the psychologist and the physiologist as well as of the engineer.

In spite of the widespread use of English, the problem of language will certainly become more acute. If one assumes that, for instance, China develops industrially at about the same rate as the U.S.S.R. has done since 1917, and takes into account the population and area of the country and its natural resources, then it is possible that within 50 years over a quarter of the world's technical literature will be in Chinese.

This is the three-fold problem, presented in broad and daunting terms, which faces the totality of British industry. What is its significance to the individual engineer? It means simply that he cannot hope to read, now or in the future, all the technical literature that concerns him. Yet it is agreed that he should not ignore it. How much, then, of this formidable total should he attempt to read or scan, and how should he select it? (There are of course other ways besides reading of trying to keep up to date, such as talking to knowledgeable colleagues and attending meetings. But these activities are spasmodic and leave gaps, and their effectiveness depends ultimately upon the informant's awareness of the literature.)

In general, reading is the best methodical way of keeping pace with knowledge. In this context reading is almost synonymous with reading *journals*. Books are necessarily a little late with the technical news. Patent specifications, unpublished research reports, university theses and conference reports sometimes contain the latest data; but normally journals are the main and most convenient source of current information.

HOW TO SELECT ?

There are thought to be at least 50,000 technical journals published, most of them probably monthly. A man who spends an average of half an hour a day, for 22 working days a month reading current literature, might expect to be able to read regularly, say eleven monthly journals at the rate of one every two days, reading in this case being taken to mean reading in full one or two articles in each issue and rapidly scanning the rest of the contents.

In practice the figure is probably lower. The results of several surveys suggest that the number of journals read/scanned regularly is between three and ten, with an average of about six. There are of course wide variations between different people: some read no current journals and others over fifty, the number depending partly upon the amount of technical reading, if any, done at home and while travelling to and from work. Nevertheless, this figure of six journals for regular reading provides a realistic basis on which to work. But which six?

For any one engineer three or four journals will probably more or less choose themselves. They will be the scientific or technical journals, with perhaps one trade journal also, solely or mainly concerned with his special sphere of work. In some well defined fields of knowledge, where papers tend to be concentrated conveniently in a few specialist journals, these three or four key journals can be expected to contain about a quarter of all the papers on the subject published in several hundred of the most " likely " journals. Information in some form about the major developments of industrial importance will certainly be found in them. Transistors, for instance, became known to the readers of most of the appropriate technical journals within a few months of the publication of Bardeen and Brattain's original paper in the *Physical Review*.

The remaining two or three journals to be read regularly cannot easily be selected from the next category of journals—" useful but not vital " specialist journals—because these will probably number three or four times the number of " key " journals. Whichever are selected, a larger number of approximately equally useful journals will be left unread.

GENERAL JOURNALS

Moreover, one, and preferably two, general engineering and scientific journals covering a wide subject field should be included in the reading list, and space should be left for them. Without them the specialist will remain too much of a specialist in his reading and will risk being inadequately informed, through his personal reading, of developments outside his immediate field of interest but impinging upon it. Several of the most useful British journals in this category are published weekly, not monthly, and hence will make a greater total call on the reader's time, but this is partly counterbalanced by the fact that they can be read more rapidly because their contents are chosen and presented primarily for reading rather than for study.

From these considerations a set of suggestions are derived which offer a practical solution to the problem of keeping up to date with current literature in so far as it can be solved by the personal reading of primary journals. It is suggested that:—

(1) Not more than four " key " journals, i.e. those devoted solely or mainly to the reader's special subject field, should be selected and scanned regularly, articles of current importance to the reader being read in full.

(2) One general engineering journal with a wide subject coverage and one scientific news journal, or two general engineering journals, should be selected and scanned regularly as above.

(3) The total number of journals scanned regularly should not be less than three (or more than ten, however many " key " journals there appear to be).

The adoption of these suggestions will enable a reader to keep abreast of the major developments in the engineering world, and to see for himself, in their original form, a useful proportion, probably about a quarter, of the important articles on his own subject.

The remaining three-quarters will be scattered among many hundreds and probably thousands of journals. This scatter has been studied by S. C. Bradford, and the results of his study embodied in a Law of Scattering, later amended by B. C. Vickery.[1] In general terms Bradford found, to quote the *Aslib Handbook*, " that only about a third of the articles on a subject are printed in the journals of that subject. A further third appear spread throughout a larger number of journals dealing with related subjects, and the remaining third in a still larger number of journals in which such articles would not normally be expected to be published."

ABSTRACTS

The significance of this is obvious: the man who reads only four specialist journals regularly, as is suggested, will probably miss between three-quarters and two-thirds of all the articles published on his subject. Even if one allows the probability that many of the articles are virtually duplicates, and some trivial, this is a serious loss. Clearly he needs some means of knowing what articles relevant to his interests are published in the many journals which he does not see.

An abstracts journal provides him with the means. It does for him what he cannot do for himself. It scans, not three or four, but hundreds or even thousands of the journals most likely to contain articles on the subject covered by the abstracts journal. The aim of the abstractors, often practising engineers or scientists, is, as a minimum, to give in a few lines enough information about the original article to enable the reader of the abstract to judge whether or not he should read the original.

The abstracts, arranged usually under narrow subject headings within the main subject, provide for most purposes the best available guide to current technical literature. Most of them include abstracts of foreign literature, thus overcoming for the reader an initial language barrier. An issue of even one of the largest and most comprehensive—*Chemical Abstracts*—can be scanned in an hour or so by a reader who confines himself to the three or four subject divisions strictly relevant to his interests. The smaller and more specialised abstract journals, such as some of those issued in this country by research associations, can be read from cover to cover in the same time. A useful list of over 70 abstract journals, the majority in English, has been published by the British Engineers' Association for its members.[2]

Abstract journals are costly to produce and some of them, even when subsidised, have high subscription rates. In spite of the cost, however, an engineer who hopes to keep up to date should scan regularly at least one abstract journal appropriate to his interests, preferably as a subscriber—if not, at some nearby library.

It will be seen that keeping up to date (within the limits practicable for one person) involves two tasks:

(1) Scanning regularly, and reading fully where appropriate, about half-a-dozen selected journals.

(2) Scanning regularly an abstract journal appropriate to one's subject interests.

These two tasks will normally involve an average of less than an hour's reading a day, and will probably cost the firm in subscriptions between £15 and £50 per year (provided that the abstract journal is not one of the most costly). Regularly performed, they will ensure that the reader is continuously well informed on the literature of his special subject, and aware of major developments in the wider technical field.

This discussion has centred round the individual engineer. In a small organisation he may be the only reader of technical literature. In larger ones his colleagues will be studying the literature also, and many more journals will be available on the premises.

All the journals selected by the engineer for regular reading should be kept for later use for at least five years—with their indexes. The indexes are extremely important, and if they are not sent automatically by the publishers to the subscribers the latter should write for them. Without indexes the journals lose much of their value when they cease to be current. With them, they will yield when required not only those articles which the reader half remembers having seen in the past, but also articles which did not interest him at the time but which later have a value because they are relevant to some current work.

The abstracts journal which he elected to scan regularly should be kept indefinitely, with its indexes. The subject indexes will enable him to find in a few minutes abstracts of a substantial proportion of the articles published on his subject. Often the abstracts themselves will provide all the information he needs. If he requires to read some of the papers in full, he will consult them in, or borrow copies from, some large library.

CONCLUSIONS

The conclusions to be drawn from this discussion are simple and heartening. They are that an engineer, even when considered as an individual working in isolation, can keep his personal knowledge of both his special and general fields reasonably up to date at a cost of

(*a*) devoting an average of up to an hour a day to technical reading (excluding major searches), the time for each individual depending on the nature of his work;

(*b*) an expenditure of £15 to £50 a year on journal subscriptions;

If he has colleagues who are also obtaining and studying literature, the literature resources of the organisation will be thereby increased; but he should not therefore eliminate his own reading of current journals.

REFERENCES

[1] If Tx represents the number of journals having x references, T2x the total number of journals having $2x$ references, and T3x the total number of journals having $3x$ references, etc., then $Tx : T2x : T3x = 1 : n : n^2$, when n may be any number depending on the value chosen for x.

[2] *BEA Information* (for members of the BEA), First Supplement No. 60/387, 7 July, 1960.

[3] Fig. 1 is taken from E. J. Crane, *Aslib Proc.*, vol. 8 (1), pp. 38-54; and *Science and Technology Act 1958, Senate Committee Hearings on*, vol. 5, 3126, Part 1, p. 170.

[4] Fig. 2 is based on a count in appropriate editions of *Willing's Press Guide*.

[5] Fig. 3 is derived from J. Day, *Symposium on the Literature of Instruments and Instrumentation*, British Scientific Instrument Research Association, 1958.

Climbing Cranes Erect Suspension Bridge Towers

Twelve months after the start of work on the new suspension bridge across the river Tamar between Plymouth and south-east Cornwall, construction of the main towers is now almost finished. The project should be completed by August, 1961. It will be a toll bridge, no grant having been obtained from the Ministry of Transport.

The history of the new bridge dates from 1954, when a technical panel appointed by the Ministry of Transport and Civil Aviation presented a report in August of that year. Consideration was given in this to increasing the capacities of the existing ferries; to the construction of a tunnel; and to the building of either a high or a low level bridge at various sites. Mott, Hay and Anderson, Consulting Engineers of London, were appointed to report on the possibilities and, on their recommendations, it was decided to construct a bridge at Saltash Passage, approximately 200 ft north of the Royal Albert Bridge, Brunel's famous structure which carries the railway across the river at this point.

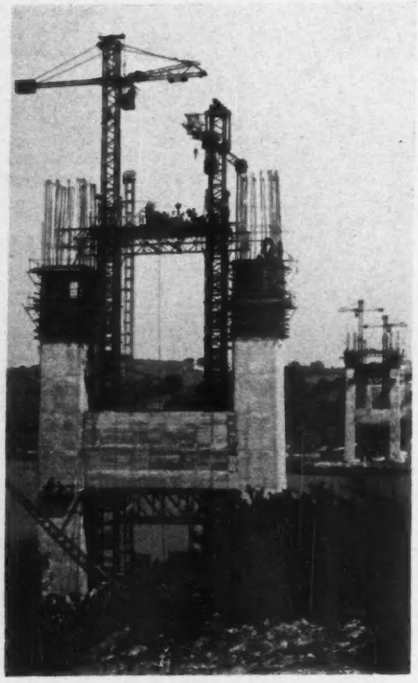
A suspension bridge, it will have a centre span of 1,100 ft and side spans of 374 ft and will carry a single 33 ft three-lane carriageway flanked by two 6 ft footways, the road level being about 130 ft above high water to allow the free passage of vessels on the river. Tenders for the work were received in June of last year and that of the Cleveland Bridge and Engineering Company Limited for £1,346,098 was accepted, this tender including the construction of the bridge, the immediate approach road on the Cornwall side and the toll booth area situated on the Plymouth side. The approach roads are being constructed by the Plymouth City Engineer's Department and the Cornwall County Council.

FOUNDATIONS

The main towers, now almost completed, rise to 250 ft above high water level. Their foundations consist of circular caissons of reinforced concrete sunk to a depth of approximately 50 ft below high water. These are each 30 ft in diameter and have a final wall thickness of 10 ft. Compressed air working was involved in all four cases.

Each tower consists of two upright reinforced concrete columns joined by two double concrete webs below the road level, one pair of webs being halfway between water level and the road and the other supporting the bridge deck itself, and a third web joins the tops of the columns. Each of the columns is rectangular in section, 14 ft square at the base and tapering to 9 ft square at the top. The use of reinforced concrete for the towers of suspension bridges is still somewhat novel. The first notable example was the Tancarville bridge over the Seine, opened just over twelve months ago.

Construction of the towers has been carried out by the use of four P25 Pingon tower cranes supplied by the UK agents, George Cohen Sons and Company Limited. The use of tower cranes for the construction of bridge work is not entirely new, of course, but the situation on the Tamar Bridge is unique in that it was necessary to devise a means of carrying the cranes outside the columns, the cavity within the towers not being large enough to accommodate them.



The nearly completed towers of the new Tamar suspension bridge.

The Pingon crane is designed to be used as a climbing crane as well as a rail-mounted or fixed-base machine, but for this particular application the normal type of climbing frame had to be replaced by a special frame constructed from bridging sections and designed to be anchored to the inner surfaces of the columns.

WORKING PLATFORMS

The distance between the inner faces of the columns is 41 ft, and it was necessary for one crane in each pair to be erected with its fixed jib above that of the other. This was done by assembling the crane towers from 9 and 10 sections respectively, giving tower heights of 74 and 84 ft. Of these, 5 sections were carried within the climbing frame, in each case.

The climbing frames were also used to carry a bridging platform extending between the two columns of each tower, these platforms providing an area on and from which the construction work could be carried out. As work progressed, further sections were added to the climbing frames on each column and both platforms and cranes were "climbed" through these sections by means of pairs of hand winches mounted on the platforms.

As the cranes were not called on for the full outreach of which they are capable—namely 99 ft—only the root section of each jib was assembled, giving a maximum working radius of 27 ft 6 in at which the permitted load was 2½ tons. This shortening of the jobs, which had the effect of allowing the lower crane in each pair to slew through a full circle without fouling the tower of its partner, was carried out without any structural modification of the cranes, on which the additional jib sections can be replaced for future applications.

The form work for the columns was supplied by Kwikform Limited, and the columns were cast in 10 ft lifts. Concrete batching plant of 1 cu. yd capacity was set up at the base of each tower.

The duties of the cranes consisted of the raising and positioning of the concrete reinforcement, handling of the formwork and pouring the concrete. Later, they will be used to raise much of the tackle for the suspension ropes to the tower heads, for the handling of the lighter steel sections for the construction of the bridgedeck and for raising the concrete for the carriageway.

Jetty for Launches at Milford Haven

Milford Haven, one of the finest natural harbours in this country and, indeed, in the world, is now being used by large oil tankers as the new Esso and BP terminals come into operation.

The Milford Haven Conservancy Board was set up by Act of Parliament in 1958, to regulate the development of the area and control shipping in the Haven, the only new conservancy board to be set up in the present century. To cope with the extensive maritime traffic which is expected to develop rapidly, the Board is to operate a small fleet of launches, 24 hours a day, every day of the year.

Posford, Pavry and Partners, of Westminster, have been appointed consulting engineers to advise the Board on all matters concerning civil engineering aspects. They have been instructed to investigate and report upon the provision of a suitable base for operating these launches, as there are at present no facilities for landing in rough weather at low tide in the lower part of the Haven. The consultants recommended that a new jetty should be built on the north shore of the Haven near Fort Hubberston.

The works will comprise an access road down the hillside and an approach jetty, 300 ft long, leading to a jetty head. One arc of the L-shaped jetty head will form a 100 ft long protective extension to the approach jetty; the seaward arm, lying parallel with the shore, will be 230 ft long, and the two arms together provide an adequate area of protected berthing on the inside while unprotected berthing will be available on the outside. The two arms of the jetty head are to be aligned in such a manner that launches berthing on the inside will obtain protection from south westerly and south easterly seas.

The proposed jetty consists of a concrete deck structure on precast piles and has a carriageway width of 10 ft 6 in between handrails.

The pier head structure consists of three reinforced concrete pontoon foundation units, which are to be built in a dry dock and towed to the site by tugs. When aligned in their proper positions, the pontoons will be allowed to settle on to the sea bed where they will be temporarily steadied by four steel piles in such a way that the top of the pontoon walls will be horizontal and at a level above that of low water neap tides. Precast concrete piles will then be driven down to the rock through slots in the pontoons. The driven piles will be connected to the pontoons to make a stable monolithic base to the structure which will have to withstand severe stresses in bad weather. The road deck on the pier head will be 21 ft wide and will be at a height of 6 ft above maximum high water. It will be supported by precast concrete diaphragm walls that are to be erected on the top of the foundation units.

Sheet steel piling will then be fixed between the deck and the top of the foundation units along the seaward side of the two arms of the pier head. This sheet piling will complete the protection of the inside of the jetty against wind and sea.

The contract for constructing the works was sent out to competitive tender in June, 1960, and has now been let to Peter Lind and Company Limited. They were the main contractors for the recently opened supertanker terminal at Tranmere for which the same consulting engineers, Posford, Pavry and Partners, designed the dual gravity-loaded floating landing stages and mooring dolphins.

The work at Milford Haven is expected to take about a year to complete at an estimated cost of about £150,000.

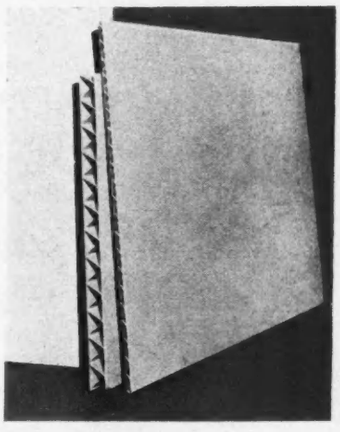
Reducing Evaporation from Service Reservoirs

Evaporation from service reservoirs might be virtually eliminated in tropical areas by the adoption of the Mansfield process. This process, which a thin layer of tasteless and odourless cetylalcohol powder to be spread over the water surface, costs no more than a 1*d* per 1,000 gallons of water saved. The powder floats on the surface forming an extremely thin protective covering that prevents evaporation. The process, which hitherto has been suitable for areas of only one or two acres, has been developed by the Australian Commonwealth Scientific and Industrial Research Organisation to make it applicable to large storage areas.

Lightweight Structural Panel

An aluminium structural panel, claimed to be stronger than any other light-alloy load-bearing panel now available, has been introduced by the Reynolds Metal Company of Richmond 18, Virginia, USA. Called " Reynocore " and shown in the illustration, the panel comprises a sandwich of two flat sheets of aluminium bonded by " Reynoweld " to a core of either corrugated or delta-formed aluminium sheet.

The internal surface, when perforated, will serve as an acoustical barrier without destroying the strength of the panel. Air pockets in the core provide adequate thermal insulation. The panels can be had in a long range of durable baked-enamel colours and in a variety of embossed designs. No further treatment need



Reynocore light-alloy sandwich panels with a corrugated core.

be applied for either interior or exterior use. The standard size is 4 ft by 8 ft in thicknesses of ½, 1, 2 and 3 in; on special order, lengths can be had up to 15 ft.

The first use of the panels will be in the roof of Coliseum 21, the theme structure of the Century 21 Exposition in Seattle. More than 30,000 panels will go into the roof, which will cover three acres.

Factory Building at Speed

Twenty-seven weeks is the building time being allowed for the erection of a factory comprising a part one-storey, part two-storey production block of 75,000 sq. ft floor area, a two-storey canteen and single-storey boiler house together with the access roads, drainage works and a car park. John Laing and Son Limited are the contractors and the factory is being built for G. B. Britton and Sons Limited, shoe manufacturers, at Kingswood, Bristol. Nearly 5,000 sq. ft of temporary accommodation has also been provided to reduce interference with output from the adjacent existing factory during construction.

Among the techniques adopted is a system of steel space frame construction, which allows the roof to be completed quickly so that building operations can continue below, however bad the weather. Draught-proof roof lights in moulded fibre glass of 6 ft span and 18 ft lengths are to be used for the production block. Elevations consist largely of an adaptation of curtain walling that has an emphasis on simplicity and lightness of treatment—flexibility and speed of erection being two particular characteristics of the adopted system. Thermalite aerated blocks are being used extensively to provide thermal insulation.

The consulting engineers for the building are Clarke, Nicholls and Marcel of Bristol, and the architects, W. H. Watkins, Gray and Partners of Bristol, London and the West Indies.

Acoustic No-Fines Concrete

The mean noise absorption coefficient of no-fines concrete over the broad frequency range (315 to 6,300 c/s) is 0·74 for material made with ⅜ to $\frac{1}{16}$ aggregates and 0·69 for one using an aggregate between ¾ and ⅜ in. Except at the lower frequencies (where the smaller aggregate concrete is the better) there is so little to choose between the two materials that for all practical purposes there is no reason to prefer one against the other in respect of acoustic properties.

For comparison, the absorption coefficient for several materials at 2,000 c/s are brickwork, 0·04; conventional concrete, 0·02; 3 in woodwool slabs, 0·8; 2 in of mineral wool on a solid backing, 0·75; no-fines concrete, 0·7 to 0·75.

The above figures have been obtained in tests made in a standard reverberation chamber at the laboratory of the Acoustical Investigation and Research Organisation. The panels were made and the tests sponsored by the Central Laboratory of George Wimpey and Company Limited, of Southall, and are reported in No. 13 of " Research and Application," the broadsheet issued by the Central Laboratory.

Concrete Piles in Sea Water

After more than 30 years of observations, it has been confirmed that the deterioration of concrete piles in sea water is due primarily to the corrosion of the steel reinforcement and not disintegration of the concrete from the chemical or physical effects of the salts in the water. The salts, nevertheless, do have an influence on the incidence of corrosion, since this becomes progressively greater as the resistance of the cement to direct attack decreased. The cement content and thickness of the cover were proved to be of major importance in determining durability.

These are the general conclusions given in the Twentieth Report of the Sea Action Committee of the Institution of Civil Engineers, just published as Research Paper No. 30 in the National Building Studies. The report is entitled *The Durability of Reinforced Concrete in Sea Water* and is published by HMSO (4*s* net).

Work on the behaviour of concrete in sea water began at the Building Research Station in 1929. Since then several reports have been issued and the present, and final, one in the series gives a summary of the scheme as a whole and of the results that have emerged. The most recent trials have shown that a concrete made with 1:5 (by weight) of ordinary or rapid-hardening Portland cement with a 2 in cover is not adequate to prevent corrosion of the reinforcement. Either a greater cover or a richer mix should be used. High alumina cements can be more satisfactory, though possible high temperature conditions have to be watched; these cements are not suitable for tropical waters.

Precast Units Made with Super-Sulphate Cement

At the first Effluent and Water Treatment Exhibition and Convention, to be held at the Seymour Hall, London, W1, 18 to 21 October next, the Lafarge Aluminous Cement Company Limited will be showing precast units made with Ciment Fondu high alumina cement. The display will include a spun concrete sewer pipe, a piling shell, and a section of iron pipe lined with Frodingham cement mortar.

Nylon Safety Harness Shows Red for Danger

The photograph shows two men at work on the Shell Building in London. They are working 350 ft above the ground and any fall would be

Scaffolders on the Shell Building, London, wearing nylon safety belts.

fatal. Safety belts under such conditions are an unquestionable asset.

Both men in the illustration are wearing belts from the " Pakawa " range made by Barrow, Hepburn and Gale Limited. The belts are made from 2 in nylon webbing which has a breaking stress of three tons and has its own built-in warning device of pending failure. A red nylon core, which alone will take only half the load of the webbing, gives a clear warning when the belts need replacing as a result of wear. Characteristics of nylon that suit it for this work is its inherent strength and lightness, its resistance to shock loading and resistance to abrasion; it is also virtually rot-proof. The belts comply with BSI requirements.

Foundations for Foundry in Four Days

The foundations for a machine shop for a factory for the American Machine and Foundry Company at Whitstable have been excavated in four days. The borings for the 115 drilled concrete piers were put down with one rig by Economic Foundations Limited, of 161 Victoria Street, London, SW1. The piers vary in depth up to 10 ft and will have diameters of either 3 ft 6 in or 4 ft 6 in. A full description of Economic Foundation's methods and of the type of rig they use was given in ENGINEERING for 19 August, p. 244.

The main contractors for the factory are Sir Robert McAlpine and Sons Limited, of Park Lane, London, W1, with whom Economic Foundations are associated. The architects are Fuller, Hail and Foulsham of London. The factory will make American type bowling alley equipment.

New Lorries Easier to Drive—and Safer

The forthcoming Commercial Motor Show at Earls Court shows what the goods vehicles of tomorrow will be like.

MUCH of the space in the vehicle section of the Commercial Motor Show is once again devoted to heavy lorries, many of which are destined to spend a high proportion of their working life on roads inadequate for them. The Show opens on Friday, 23 September and closes on 1 October.

Strangely enough, the defects of our roads seem to have very little effect on current design trends, with the exception that improvements have been directed at making the lorry driver's job easier and therefore safer. More attention is being paid to cab layout to provide better lookout, a more comfortable driving position and greater ease of access. A good example of what is being done is provided by the new Bedford TK range of forward control truck, with the engine mounted just behind the cab, that was fully described in our last week's issue.

British Motor Corporation

Austin and Morris have both recently introduced similar new 1¼ to 4 ton ranges of trucks, in which the elimination of driver fatigue has been the prime consideration. Forward control with the engine in the cab is retained, and the improvements include a full-view wrap-around windscreen, with provision of portholes in the bottom front corners of the cab to assist parking visibility. Ease of entry and improved rearward lookout are obtained by setting the cab doors back at an angle of 45°. This also permits either door to be opened fully without interfering with passing traffic.

Rootes Group

Among the lighter commercial vehicles Commer Cars are introducing a ¾ ton forward control range of light goods and passenger models, which can be bodied in over 20 ways for different applications. They have independent front suspension and driver comfort follows the usual forward control arrangement with the engine in the cab.

A choice between petrol and diesel engines is offered, the petrol being a 4-cylinder o.h.v. 1,494 c.c. unit developing 49 b.h.p. at 4,500 r.p.m. the diesel alternative is a Perkins 4-cylinder 1,621 c.c. engine of the indirect injection type, developing 40·5 b.h.p. at 3,600 r.p.m.

Leyland Motors

As a large exporter of heavy duty vehicles, Leyland have just introduced a new range of heavy duty trucks intended mainly for overseas, with gross ratings of from 14 to 24 tons. The three basic models in the range are the 4-wheeled Beaver, 6-wheeled Hippo and 8-wheeled Octopus, with Leyland's Power-Plus 0·600 9·8-litre 140 b.h.p. diesel engine as standard. The larger Power-Plus 0·680 11·1-litre 200 b.h.p. engine can be fitted as an alternative.

A forward control arangement is used with the engine in the cab which at first sight appears strictly conventional. However, the steering, clutch and handbrake are all power assisted, and the cab, made either of pressed steel or glass fibre, has been restyled to provide better visibility and easier access to the mechanical parts for maintenance.

From Leyland's subsidiaries, Albion and Scammell, the most noteworthy newcomer is the Scammel Handyman 24 ton matched articulated outfit, the forward control version of the bonnetted Highwayman articulator. Moving the engine into the cab has been done to shorten the tractor unit wheel base and obtain increased platform length, but at the same time full advantage has been taken of the improved driving position. Better all-round lookout and more comfortable seating are the result.

British Railways' Roadrailer

Undoubtedly the most revolutionary vehicle at the show is the brand new Roadrailer, developed jointly by British Railways and the Chesapeake and Ohio Railway of the USA, and built by the Pressed Steel Company of Cowley, Oxford. For road work the roadrailer runs as a semi-trailer with any suitable standard road tractor. By moving a handle the rail wheels can be lowered and the road wheels raised in one operation for running on rails, in which condition the front end is carried either on a special 4-wheel rail truck or by the rear of similar vehicle.

The roadrailer provides an entirely new conception of the problem of easy exchange of goods traffic between road and rail. It is intended that complete trains of roadrailers will be formed for the rail portion of the journey between two distant railheads, and the road travel facility will enable door-to-door delivery to be made quicker than if the journey were made by road alone. This vehicle could materially alter the pattern and economics of inland transport in this country.

BP Autotanker

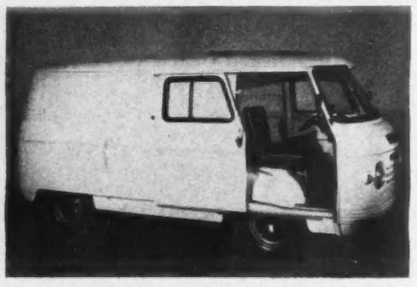
Another revolutionary vehicle on show is the Autotanker, developed by the British Petroleum Company and built by Thompson Brothers (Bilston) Limited in collaboration with Leyland. Combining the tank-body, cab and chassis into one unit enables this 24 ton vehicle to achieve a 70 per cent payload, and the lower centre of gravity compared with a conventional tanker gives excellent roadworthiness. The engine is rear mounted and the 4,000 gallon capacity liquid container is divided into six separate compartments.

The Autotanker has a wrap-around windscreen, and a periscope giving a view of the road behind gives the driver an all-round lookout, Power-assisted steering is fitted. The 200 h.p. Leyland 11·1 litre Power-Plus diesel engine, in unit with a semi-automatic gearbox, will give a cruising speed of around 50 m.p.h.

Smith's Delivery Vehicles

Despite their potential advantages for short-haul delivery work only one firm, Smith's Delivery Vehicles Limited of Gateshead, are showing any battery electric vehicles. Smith's emphasis is on products for the overseas market, and their NCB Electric Commuter van, as developed for the USA, is being shown. This is designed to operate at 20 to 25 m.p.h. and incorporates some new features, including a "ThermX" cab heater.

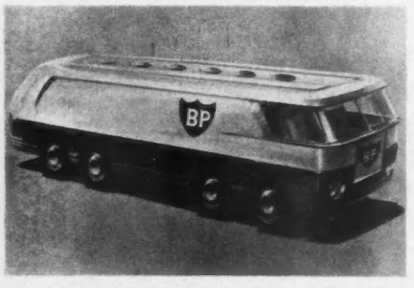
Morris 1½ ton series 4 commercial, showing the front cab portholes and large windscreen.



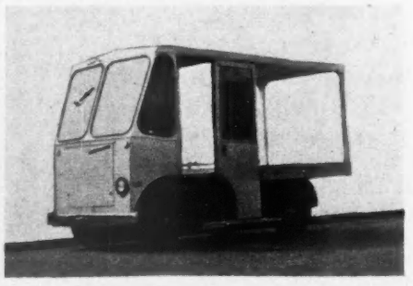
Commer ¾ ton forward control van. This range includes vehicles for goods or passengers.

24 ton Leyland Octopus, with lightweight body and choice of 140 or 200 b.h.p. engine.

BR's Roadrailer, made by Pressed Steel, as a road vehicle, with rail wheels retracted.



The BP Autotanker looks more like a luxury coach, and is intended for world-wide operation.



One of the few battery electric vehicles on show, the Smith's Suburbanite dairy truck.

Compact Reactors

KEEN interest has been shown at an international level for the International Atomic Energy's Conference on Small and Medium Power Reactors held in Vienna from 5 to 9 September. More than 250 participants from 39 countries, the United Nations and six international organisations attended the third major conference of the Agency, at which 54 papers were presented. The Western Bloc were the main contributors, only two papers coming from behind the Iron Curtain, of which the one from the Soviet Union was entered during the conference. The sessions were divided into themes entitled: general review of reactor systems; experience in construction and operation; safety, fuel cycles and staffing; costs evaluation and economics of nuclear power plants; the role of small and medium power reactors in meeting energy problems, and international cooperation.

Operating and Projected

This conference has done much to impress upon the delegates the importance of the role that nuclear power will play in the future. At present 1,000 MW of nuclear capacity are in operation and more than 28 nuclear plants with an aggregate power of nearly 4,500 MW are under construction. By 1966 if all the announced plans came to fruition there will be more than 8,000 nuclear MW in twelve countries. The status of the small power reactor in the future will be important, but at present the chief emphasis is on the larger reactors. This is caused by the more immediate need for countries financing the majority of the projects requiring power on the larger scales. But it does not follow that countries, such as the United States, are not giving the smaller reactor any consideration. It has been amply shown at the conference that they are.

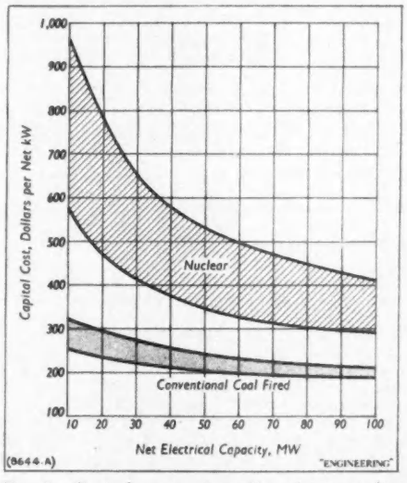


Fig. 1 Capital costs of small and intermediate nuclear and coal-fired plants.

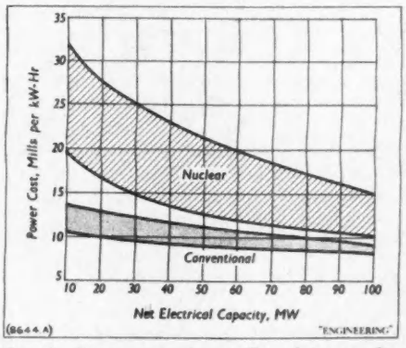


Fig. 2 Power costs in small and intermediate plants.

Scaling Down and Economics

Although it would be fair to say that the small reactor of any particular type may be a scaled down version of its "big brother", a large amount of research and development is still required and often major modifications will be necessary. One of the main restrictions to the small reactor is economics, as may be gathered from Figs. 1 and 2 which are taken from a paper by J. A. Lane of the Oak Ridge National Laboratory. They show the difference between nuclear and conventional coal-fired electrical generating plants for both capital and fuel costs.

Where Small Reactors Pay

The potential buyers of the small and medium sized reactors are the less developed countries whose budgets are already over-strained. It will therefore require a very far sighted exchequer to unloose the purse strings for such an expensive item as a reactor in the range that will most interest the country concerned, especially if it has an adequate supply of fossil fuel to hand. It is not until freight or import prices for the transport of fossil fuel over large distances become critical that nuclear power can become competitive in present circumstances. Thus the latest step of erecting a reactor in Antartica is an economic success when the high capital costs are offset by the long nuclear fuel life and resultant lack of transport problems. Table 1 is based on a twenty-year cycle, and total operating cost and interest changes are included. (Taken from "The Army Nuclear Programme—its reactors and their application to less developed areas of the World," J. K. Brattan.)

Reduce Operating Pressure

Much has been said about possible reductions in the price of reactor construction and fuel fabrication costs to be expected within the next few years. But one method presented by R. E. Strickland and D. Rudd of the United Kingdom in a paper titled "LPR—A 30 MW natural-uranium nuclear power station" gave a new approach to cutting cost. The argument is that in recent years the tendency has been to raise the reactor pressure higher and higher in the large 250 MW(e) gas cooled reactors operating at high load factors. This pressure increase brings an increase in temperature and heat transfer. Mr. Strickland suggests that an alternative, which has been overlooked for the smaller unit of about 30 MW, is to lower the operating pressure.

Cheaper Fabrication

Fig. 3 shows that although the cost of individual items vary considerably over the pressure range taken, the overall cost is virtually constant. Since a reduction in pressure will decrease the thickness of the pressure vessel and hence ease fabrication, the pressure may be selected on other than operating considerations. The circulators may be large but not unmanageable if 60 lb per sq. in is chosen, for example. The optimum fuel cycle is dependent upon the maximum irradiation to which the elements may be subjected without excessive can failure.

Dwell Time 20 Years

Fig. 4 shows the dwell time of the fuel in the core and the average irradiation at various station load factors. Thus at 40 per cent load factor, to obtain an irradiation of 2,160 MWD per tonne, the dwell time would be 10 years. That is if the magnesium alloy cans can survive the prolonged period. This leads to fuel changing two or three times in the twenty year cycle—permitting very simple charge and discharge equipment which may be operated at shutdown periods, and also very low running costs. A much improved site layout is also suggested giving a reduction in capital costs. Economic comparison with the pressurised-water reactor shows the system to be superior in many cases, but all this has to be proved from a practical stand-point.

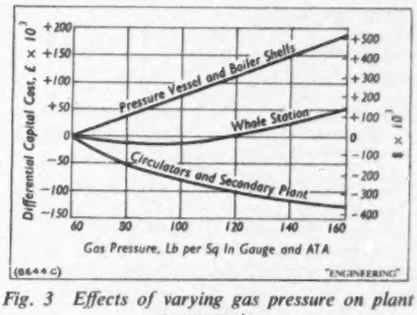

Differential Capital Cost, £ × 10³
Pressure Vessel and Boiler Shells
Whole Station
Circulators and Secondary Plant
Gas Pressure, Lb per Sq In Gauge and ATA
(8644-C)
"ENGINEERING"

Fig. 3 Effects of varying gas pressure on plant components.

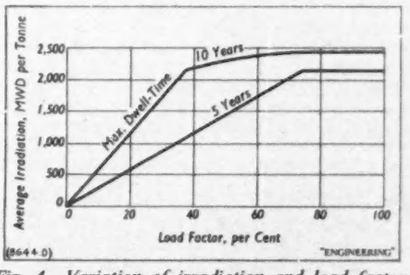


Fig. 4 Variation of irradiation and load factor at 5 and 10 year dwell times.

Spectral Shift Control Reactor

A variation of the pressurised water reactor which shows promise of reducing both fuel and capital costs is the Spectral Shift Control Reactor. The "built-in" excess reactivity in the PWR core to achieve long life is balanced out by modifying the neutron spectrum so that the resonance absorption in the fertile material is markedly increased. The "shift" in the neutron spectrum is produced by mixing a certain amount of heavy water with the ordinary water in the primary system. As the core is depleted the concentration of the heavy water is decreased to reduce resonance absorption, so that more neutrons are available to continue the chain reaction. By shifting the neutron spectrum towards the resonance region at the beginning of operation with a new core, the fertile material acts as a central rod and neutrons normally lost produce new fuel, thereby improving the con-

TABLE I:—*Comparison of Site Costs for Nuclear and Conventional Plants*

		Initial capital investment		Cost of diesel fuel per gal	Cost of power, mills per kWh*	
		Nuclear	Conventional		Nuclear	Conventional
Washington	(3 MW(e))	$3,800,000	$550,000	$0·103	57	15
Remote Section of Alaska	(3 MW(e))	$7,500,000	$2,000,000	$0·440	90	60
Antarctica	(3 MW(e))	$11,500,000	$4,500,000	$1·060	67	102
Guam (Pacific Island)	(20 MW(e))	$17,500,000	$8,500,000	$0·108	16·4	15·1

* Total (government) operating cost, including 20-year amortisation and interest charges.

version ratio. This leads to neutron economy and improvement in power distribution, since no control rods need be inserted in the core when the reactor is at full power. It is estimated that a given PWR primary reactor system can produce 70 per cent more power when operated as a SSCR, due to the improved power density. (M. C. Edlund—" The Spectral Shift Control Reactor.")

Notes and News

HECTOR: for Materials Evaluation

The United Kingdom Atomic Energy Authority have signed a construction contract with Fairey Engineering Ltd., and a control-gear design contract with H. M. Hobson Ltd., in connection with a new zero-energy oscillator reactor which is to be built at the Atomic Energy Establishment, Winfrith. The reactor, which will be called HECTOR (Heated Experimental Carbon, in the form of graphite, Thermal Oscillator Reactor), has been designed expressly to facilitate the use of the " pile oscillator " technique for evaluating the nuclear behaviour of fuels, moderators, and structural materials in reactors. This technique, which utilises small samples, has been developed by the UKAEA to further the reactor physics aspects of power-reactor development. HECTOR is expected to go critical during 1962. HECTOR possesses a unique feature, in that it is possible to reproduce closely the conditions appropriate to many different designs of power reactors. It is believed to be the world's first reactor in which oscillator measurements can be made in such a wide range of conditions.

Pile Oscillation

The reactor core is an annulus of graphite and highly enriched uranium/aluminum alloy within which various assemblies of fuel and moderator may be constructed around a central tube. The sample under investigation will be cycled through this tube, producing oscillations in reactor power level from which the nuclear behaviour of the sample, under the conditions reproduced by the assembly can be determined. Since the fuel material in the assembly may be natural or enriched uranium 235, plutonium, thorium, uranium 233 or irradiated elements from power stations, and since the assembly can be heated to 450° C, it is possible to investigate samples under the conditions to be found throughout the life of many different designs of power reactors.

Fine Stability

Successful measurements are possible only if the temperature of the heated assembly is extremely stable. It is desirable that the moderator temperature should not change by more than three thousandths of one degree centigrade per minute. The design of the reactor to achieve this has involved the use of novel techniques, specialised materials and the highest standard of control and instrumentation.

Reports Received

Hydrogen Absorption by Oxidising Zirconium: Increase in temperature or weight gain increases the percentage of corrosion hydrogen absorbed by zirconium and its alloys. Only elements between chromium and copper in the first long period of the Periodic Table give percentage absorptions greater than 30 per cent when added to zirconium. Elements higher in the table give between 2 to 15 per cent absorption at low temperatures. (B. Cox *et al.*: " The Oxidation and Corrosion of Zirconium and Its Alloys," Part X, AERE-M621.)

Beds of Fluidised Particles: A literature survey for the period 1940-59 of heat transfer in fluid beds with particular emphasis on gas supported systems. Mention is also made of liquid fluidisation. (H. Bannister: " Heat Transfer in Beds of Fluidised Particles," AERE-R2996.)

Decomposition Effects of Sodium Iodide: Carrier-free Sodium Iodide I-131 is slowly oxidised in aqueous solution forming iodate and iodine. This can be prevented with the use of sodium thiosulphate. (J. S. Burgess and E. J. Partington: " Radiation Decomposition Effects in Aqueous Solutions of Carrier-Free Sodium Iodide.")

Radiation Tracer Methods for Testing Filters: Application of radioisotopes as an alternative method for the testing and measuring of filter efficiencies is an improvement on traditional methods. (J. Webb: " Investigation into the Possibility of Using Radioactive Tracer Methods for Testing Filters.")

Atmospheric Tracers: Separation methods for the measurement of small quantities of radon decay products collected on air filters and in rainwater have been developed giving information about atmospheric processes. (" Radiochemical Analysis of Long-Lived Radon Decay Products and their use as Natural Atmospheric Tracers," AERE-HP/R2084.)

Renewed Interest in Nuclear Blasting

In advanced stages of planning are nuclear excavation projects both in the United States and the Soviet Union. Creation of a harbour in Alaska is now awaiting the political approval of the United States Government, while in the Soviet Union plans have been advanced to build a 150 mile tunnel under the Caspian Sea which would connect the Baku oilfields with the industrial areas of Central Asia. The Soviet plans call for the detonation of very small nuclear devices (probably with some form of charge-shaping) as it is claimed that the rate of advance would be some 300 metres on a front of only 10 to 15 metres wide with every nuclear blast. (*Technical Digest*, July 1960.) The Soviet Union is known to have considerable experience with large scale rock excavation using megatons of conventional explosives, and it is possible that extensive underground nuclear tests were sandwiched between the conventional test-series.

Gamma Field at Trombay

India is planning the creation of a second gamma field in the vicinity of Trombay, the headquarters of the Indian Atomic Energy Commission. The first gamma field, already in operation near New Delhi, is used to determine the effect of radiation on the growth and reproduction of plants. The Trombay field will be similar but on a larger scale, and will be used for the development of improved strains of crop plants, said Dr. Homi Phabha, chairman of the Commission.

Blending Uranium of Different Enrichments

Uranium of different degrees of enrichment may be mixed or blended isotopically. Blending results in some loss of separative work, but in certain circumstances this may be advantageous. For example, after enriched uranium has been irradiated in a power reactor, re-enrichment by blending with uranium of higher fissile isotope content may be economical if the cost of the lost separative work is less than the cost of converting the spent uranium into uranium hexafluoride for re-enrichment in a diffusion plant. For an ideal diffusion cascade the separative work required to produce the blending ingredients is greater than the work required to produce the final product directly in the cascade. (*Methods of Calculating U-235 Outputs and Charges by Use of Ideal Cascade Theory*, USAEC publication TID-8522.)

Bright Prospects

Important price reductions are deemed possible within the next decade in the price of nuclear power generation. The philosophy behind this view is contained in a report prepared for the fourth regular session of the International Atomic Energy Agency's General Conference in Vienna on 20 September '60. The USAEC have recently extimated that the generating cost for a 200 MW(e) reactor fuelled with slightly enriched uranium and an 80 per cent plant factor will fall between 11 and 14 mills per kWh. The possible reductions in fuel-cycle costs, higher burnups, a fall in uranium prices, and other simplifications on reactor design may all reduce the cost to 9 or 10 mills per kWh.

Manual Calculation of Gamma Flux Outside Core

Based on the Swedish reactor R3b, the value of mathematical approximations in determining the gamma-ray flux outside a reactor core has been investigated by Matts Roos of the Finland Institute of Technology. A cylindrical heterogeneous thermal reactor using cylindrical fuel elements is assumed, and the methods comprise three degrees of approximation: homogeneous uniform source; homogeneous nonuniform source; and distributed line sources in a homogeneous medium. All methods are suitable for manual calculations. The first approximation gives conservative values for low-energy sources and is suitable for shielding calculations of shut-down reactors. The second approximation is also conservative, but is suitable for higher energy sources. Using two energy groups and assuming a pure moderator, the third approximation gives good results, and can be arranged conveniently for computer programmes. The method can also be generalised to calculate the flux at any point within the core or on the core surface. (Matts Roos: Approximate Gamma Ray Flux Calculations Outside a Reactor Core, *Acta Polythechnica Scandinavica*, APS Ph. 4, 273/1960.)

Energy Dissipation by Fast Electrons

Calculation of the penetrating power of electrons in various media is important both in health physics and in the industrial application of radiation sources. A monograph of the US National Bureau of Standards presents computed data in very close agreement with experiment for the spacial distribution of energy transferred to surrounding material by fast electrons emanating from point or plane sources. Tabulations are given for carbon, aluminium, copper, tin, lead, air and polystyrene, with initial electron energies from 0·025 to 10 MeV. (*NBS Monograph 1*, US Department of Commerce.)

Euratom Joins in Dutch Suspension Study

Since 1956 Reactor Centrum Nederland and the Arnhem electrical firm KEMA have been conducting studies on an aqueous homogeneous suspension reactor (Geneva paper P1827). Recently an agreement has been signed through which Euratom would assist both financially and through trained personnel in speeding up the programme. KEMA is now operating a number of high-pressure test loops which will provide the necessary design data for a 250 kW experimental reactor. Fission product separation, circulators and vortex separators are being developed, and an extensive physical and chemical programme has been initiated. The RCN-Euratom agreement is to run for three years. (*Annual Report*, Reactor Centrum, Nederland, 1959.)

Whole-Body Monitor for Windscale and Dounreay

To facilitate the pinpointing and measurement of internal contamination, the Atomic Energy Authority have ordered two whole-body radiation monitors, one for Windscale and one for the Dounreay establishment. The instruments will consist of one small scintillation head for locating the source of radiation, and four large sodium iodide scintillation crystals for accurate radiation counting. The sensitivity of the counters is such that in five minutes radiation equivalent to one-hundredth of the permissible dose can be measured.

Lockheed Training Reactor

The United States Atomic Energy Commission has announced plans to issue a permit to the Lockheed Aircraft Corporation's Georgia Division to produce a low-power nuclear reactor, which will be exhibited in Latin America. The reactor is now in the process of erection at the Georgia Division's nuclear laboratories near Dawsonville. After approval, the reactor will be leased to the Commission and will be operated by Lockheed staff under contract at Argentina's sesquicentennial celebration in Buenos Aires this autumn. The training reactor will be part of an Atomic Energy Commission display similar to one now in Cairo. Later it will be shown in Brazil, Peru, Venezuela, and possibly other Latin American countries.

Brookhaven Accelerator at Full Power

The most energetic particle beam ever produced by man recently travelled round the magnetic track of the Brookhaven accelerator. In a trial run the design energy of 30 GeV was exceeded by a slight margin, although the accelerator is not yet ready for any useful experiments.

'Engineering' Appointments Section

THE GOVERNMENT OF NORTHERN NIGERIA

requires

3 EXECUTIVE ENGINEERS (ELECTRICAL)

on favourable contract terms

QUALIFICATIONS: A University Degree or Diploma exempting from Parts I, II and III of the Institution of Electrical Engineers examination, OR to have passed Parts I, II and III of the Institution of Electrical Engineers examination or be otherwise experienced in all. In addition any of the following will be an advantage:—

(i) Several years experience in the design, specification of contracts associated with the electrical installation in Public Buildings, and water pumping stations.

(ii) Experience in one or more of the following:—

Medium voltage distribution.

Street lighting.

Air conditioning plant.

Refrigeration.

Diesel Engines.

Automobile Electrical Equipment.

Supervisor control of SKH.

DUTIES: The preparation of design, specification and estimates, together with the supervision and maintenance of:—

(a) Electrical installations in Public Buildings, .R.H. Quarters, Hospitals, Schools, Water Pumping Stations, etc.

(b) Diesel engine driven generating plant up to 300 kVA.

(c) Medium voltage, overhead line and underground cable distribution.

(d) The supervision and training of subordinate staff.

EMOLUMENTS: (1) SALARY. According to qualifications and experience in the range of £1104-£2202.

(2) OUTFIT ALLOWANCE of £45 and camp equipment allowance of £40 on first appointment.

(3) RESETTLEMENT GRANT of £37 10s. 0d. for each three months service inclusive of earned leave payable on satisfactory completion of contract.

(4) CHILDREN'S ALLOWANCE. £120 for one child, £216 for two and £288 for three children eligible.

(5) FIRST CLASS PASSAGES for officer and wife on appointment and on leave, and assistance towards cost of children's passages.

LEAVE. Generous home leave on full pay.

Applicants should write to: THE RECRUITMENT SECRETARY (OVERSEAS), NORTHERN REGION RECRUITING AGENCY, NIGERIA HOUSE, 9 NORTHUMBERLAND AVENUE, LONDON, W.C.2, or telephone: TRAfalgar 1244, Extension 145.

C 978

AUSTRALIA

RYLANDS BROTHERS (Australia) PROPRIETARY LTD., NEWCASTLE, NEW SOUTH WALES.

This Company is the major subsidiary of Australian Wire Industries Pty. Ltd., and is inviting applications to fill the following positions.

DESIGN ENGINEERS
General design of wiredrawing and wire processing plant, equipment and buildings in a works producing 3000 tons per week of steel wire.
3 positions
Qualifications: Engineering degree or H.N.C.

DETAIL DRAUGHTSMEN
Detail draughting of wiredrawing and wire processing plant, equipment and buildings working under the supervision of qualified design engineers.
4 positions
Qualifications: O.N.C.

MARINE ENGINEER
To supervise plant maintenance of wiredrawing works and services, including steam generation with possible promotion to Foreman Mill Fitter in charge of 35 fitters and labourers.
1 position
Qualifications: O.N.C. with marine experience.

CONSTRUCTION ENGINEER ASSISTANT
General Supervision of plant construction work under direction of the Construction Engineer.
1 position
Qualifications: O.N.C.

SENIOR METALLURGISTS
General plant metallurgical investigation and control work on wiredrawing and wire processing of high and low carbon wires at a plant producing up to 3000 tons of steel wire per week. Responsible to Chief Metallurgist.
3 positions
Qualifications: Metallurgical degree or H.N.C. with L.I.M.

ASSISTANT METALLURGISTS
Generally assisting and directed by plant metallurgists on investigation and control work associated with the production and processing of ferrous wire high and low carbon at a plant producing up to 3000 tons of steel wire per week.
4 positions
Qualifications: O.N.C.

CHIEF CHEMIST
To take control of chemical laboratory on a steel wire plant and be responsible to the Technical Superintendent. Duties will include the introduction of latest instrumentation for analytical work and supervise the work of 6 or more junior chemists.
1 position
Qualifications: B.Sc. (Chemistry)

PHYSICIST
To organise investigation and control work associated with a steel wire plant reporting to the Technical Superintendent.
1 position
Qualifications: B.Sc. (Physics)

PRODUCTION ENGINEERS
To carry out job methods analyses and time studies on various production processes in a steel wire mill producing 3000 tons of wire per week.
2 positions
Qualifications: O.N.C.

Please address applications in writing to

BOX "A.R.B."
c/o J. W. VICKERS & CO. LTD.,
7, GREAT WINCHESTER STREET,
LONDON, E.C.2.

C 943

PUBLIC APPOINTMENTS

STATION ENGINEERS (G.D. & MECH.)

AIR MINISTRY require STATION ENGINEERS (G.D.) and STATION ENGINEERS (MECH.) at R.A.F. and Ministry of Aviation Stations. The work of Station Engineers (G.D.) consists of installation, operation and maintenance of high and medium voltage electrical distribution systems, electrical power and lighting installations, control systems and generating plant: knowledge of heating and ventilating plant and diesel engines an advantage. Station Engineers (Mech.) are concerned with diesel power plant, steam and hot water heating systems, refrigeration and air conditioning and miscellaneous workshop plant, tools and equipment. Candidates must hold O.N.C. or Mech./City and Guilds Electrical Technician's Certificate/2nd Class M.O.T. Certificate or equivalent and must also have had recognised apprenticeship with firm of good repute plus 3 years' employment in electrical or mechanical and engineering, preferably on operation and maintenance of mine, factory or workshops plant and services. Preference to candidates with supervisory experience.

Commencing salary dependent upon age, qualifications and experience and ranges from £770 to £875 rising by annual increments to £925. Opportunities for promotion up to Tech. Grade A, maximum salary £1680 (National rate). Pension prospects. Five-day week. 18 days paid leave a year initially. Internal training courses provided and attendance at technical colleges by suitable candidates is sponsored. Overseas tours for which special allowances are payable in addition to higher salary. Applicants, who must be natural born British subjects, up to age 55, should write stating age, qualifications and experience to MANAGER (P.E.1), PROFESSIONAL AND EXECUTIVE REGISTER, MINISTRY OF LABOUR, ATLANTIC HOUSE, FARRINGDON STREET, E.C.4. No original testimonials should be sent. Only applicants selected for interview will be advised. G 892

GOVERNMENT OF UGANDA

FACTORIES INSPECTOR (ELECTRICAL), male, aged 25-35, required to advise the Chief Factories Inspector and Factories Inspectors on electrical safety in factories and other industrial places, and to inspect Factories, etc., for enforcement of safety rules in electrical matters. Degree in Electrical Engineering or equivalent (e.g. Graduate Membership of Institute of Electrical Engineering and subsequent completion of Recognised Graduate Apprenticeship in Electrical Engineering) essential. Experience of the Investigation and Prevention of Electrical Accidents and experience of United Kingdom Electricity Regulations made under the Factories Acts desirable. Post permanent and pensionable or on contract/resettlement grant terms if preferred. Salary at appropriate point in scale £939 to £1863 inclusive. Quarters at low rental. Free passages and medical attendance. Education allowance (in respect of children educated in secondary schools outside Uganda). Low income tax. Generous home leave.—Further particulars and application forms from DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1, quoting BCD 132/9/02/D5. *Candidates should state their full names when applying.* C 910

ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS

AIR MINISTRY require ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS for design, construction and maintenance of installations on airfields, radar stations, missile bases, workshops and maintenance units for R.A.F. at home and overseas as well as certain Civil Airports. Salary: £805 at 25 to £1095 at 34 or over, thereafter rising to max. £1260 with increase for London and slight decrease for country districts. Appointments non-pensionable but long term. Promotion prospects. Five-day week with 4 weeks 2 days leave a year initially. Special allowance in addition to salary during overseas service. Qualifications and experience:

(i) (a) University degree or equiv. diploma in electrical and/or mechanical engineering with at least 2 years' apprenticeship; or
(b) Graduate or corporate member of I.E.E. with at least 3 years' apprenticeship; or
(c) Graduate or corporate member of I.Mech.E. appreciable electrical engineering experience with at least 3 years' apprenticeship; and

(ii) Have been employed for minimum of 2 years with well established engineering concern and gained wide experience in both electrica and mechanical engineering practice.

Applicants must be natural born British subjects between ages of 25 and 45.

Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting D.158/OA. C 771

MANCHESTER CORPORATION WATERWORKS UNDERTAKING

Applications are invited for the appointment of DEPUTY ENGINEER AND MANAGER of the Manchester Corporation Waterworks Undertaking. Applicants should be Civil Engineers with administrative experience, preferably having a wide experience of the design and construction of large civil engineering works for water supply.

Commencing salary £2753 per annum, rising by annual increments of £90 to £3023 per annum.

Details of appointment and application forms (returnable by 26th September, 1960) from the SECRETARY, WATERWORKS DEPARTMENT, TOWN HALL, MANCHESTER, 2. C 822

BOROUGH POLYTECHNIC, BOROUGH ROAD, S.E.1

PRINCIPAL: JAMES E. GARSIDE, M.Sc.Tech., Ph.D., F.R.I.C., F.I.M., F.INST.F.

The Governors invite applications for the following appointments:—

DEPARTMENT OF MECHANICAL ENGINEERING

Head of Department—G. L. H. Bird, B.Sc.(Eng.), M.I.Mech.E., M.Inst.R.

LECTURER IN MECHANICAL ENGINEERING—Specialising in Engineering Thermodynamics and Heat Transfer.

Applicants should be university graduates in Mechanical Engineering, with industrial, research and/or teaching experience. A post-graduate qualification or specialised industrial experience in the required fields would be an added qualification. Courses involved include "Sandwich" Diploma Courses, and will be mainly concerned with the above-named subjects. Excellent opportunities and facilities for research.

ASSISTANT LECTURER (GRADE B) IN MECHANICAL ENGINEERING

Applicants should be university graduates in Mechanical Engineering, with industrial experience and an aptitude for teaching. Candidates should be able to teach Engineering Science and Engineering Drawing to at least Ordinary National Certificate standard, but opportunities will be given for participation in advanced courses and research.

SALARY SCALES

Lecturers (Men)—£1370 by annual increments of £35 to a maximum of £1550, plus London Allowance of £38 or £51 per annum according to age.

Assistant Lecturers (Grade B), £700 by annual increments of £27 10s. to £1150, plus allowances for training and qualifications and the London Allowance of £38 or £51. Candidates may be placed on the scale at a point appropriate to teaching and/or industrial experience.

Application forms and further particulars obtainable on application to the undersigned.

FREDK. J. PACKER,
CLERK TO THE GOVERNING BODY.
C 931

TECHNICIAN

MINISTRY OF AVIATION requires TECHNICIAN at LONDON to assist in compilation of glossaries of item names for mechanical components using the NATO supply classification system. QUALIFICATIONS: Recognised engineering apprenticeship. O.N.C., C. & G. Final Certs. or equiv. Knowledge of domestic and NATO cataloguing procedure is desirable. SALARY: £875 (age 28)-£975. Application forms from MANAGER (P.E. 2830), MINISTRY OF LABOUR, PROFESSIONAL AND EXECUTIVE REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4. C 938

LONDON COUNTY COUNCIL

WANDSWORTH TECHNICAL COLLEGE—Required JANUARY, 1961, HEAD OF ELECTRICAL ENGINEERING DEPARTMENT, comprising part-time day and evening classes in Electrical Engineering to H.N.C. and Endorsement standards, also extensive C. & G. and trade courses; should hold degree in Electrical Engineering and Corporate Membership of an Engineering Institution; industrial and technical teaching experience essential.

Salary, Burnham Grade 3, Head of Department, £1800 by £50 to £1950, plus London Allowance.

Full details and application form from SECRETARY AT COLLEGE, WANDSWORTH HIGH STREET, S.W.18, returnable by 5th OCTOBER. Please quote ref.: (FE3A/TE/2302/9). C 932

Machine Tool Industry Research Association

Negotiations are now well advanced for the formation of a D.S.I.R. grant aided Research Association for the Machine Tool Industry and applications are accordingly invited for the post of

Director of Research.

In the initial period, work on research projects would be placed out under contract with existing Research Centres under the supervision of the Director to be appointed.

The post demands the highest administrative and negotiating ability, academic qualifications and technical experience. It will carry a salary commensurate with these requirements. The post will be pensionable.

Written application, which will be treated in the strictest confidence, should be submitted within one month from the date of this advertisement to:—

The Chairman of Council,
Machine Tool Industry Research Association,
Brettenham House, Lancaster Place, London, W.C.2.

Envelopes should be clearly marked "R.A. Application."

C 950

Super Oil Seals & Gaskets Ltd.

WORKS MANAGER

A Works Manager is required to take charge of the Company's light engineering division in Birmingham which employs 800 and is still growing. The Company's total staff numbers about 2,000.

Works Managers who have had the experience of planning and organising production for a plant of similar or larger size are invited to apply for this appointment. Applicants must have had practical machine shop and press shop experience.

Salary for this important position will be commensurate with qualifications and experience. The Company has a generous superannuation and life assurance scheme.

Write, stating age, qualification and experience to:

THE DIRECTOR & SECRETARY,
SUPER OIL SEALS & GASKETS LTD.
KINGS NORTON, BIRMINGHAM, 30.

C979

SOUTH EAST METROPOLITAN REGIONAL HOSPITAL BOARD

Applications invited for the following posts:—
(*a*) ENGINEERING DRAUGHTSMAN (ELECTRICAL)
(*b*) ENGINEERING DRAUGHTSMAN (HEATING AND VENTILATING)

Salary within the range of £570-£1300 according to experience and qualifications. Preference will be given to candidates who hold the Higher National Certificate or Sections A and B of the Institution of Heating and Ventilating Engineers (or equivalent) and have had suitable practical and theoretical training including site or workshop experience. Consideration will be given to experience as alternative to qualifications.

Applications, stating age, qualifications, experience and present salary, with names of three referees should reach the SECRETARY, 40, EASTBOURNE TERRACE, W.2, by 26th SEPTEMBER. C 966

CITY OF BIRMINGHAM PUBLIC WORKS DEPARTMENT MECHANICAL AND ELECTRICAL SECTION

Applications are invited for the following posts in the Design Office.

(*a*) SENIOR ENGINEERS (Heating and Ventilating). A.P.T. IV (£1065/£1220 p.a.).
(*b*) ASSISTANT ENGINEER (Heating and Ventilating). Special Grade (£785/£1070 p.a.).

Applicants must be Associate Members of the Institution of Heating and Ventilating Engineers, or hold the Higher National Certificate in Mechanical or Electrical Engineering (with five years' experience).

Duties undertaken in this office include the design of mechanical, electrical and heating services and installations in Civic Buildings, municipal offices, multi-storey flats and other dwellings, car parking garages, fire and police stations, schools, baths, salvage destructor plants, pumping stations, etc.

Applicants must have had experience in the design, specification and supervision of contracts associated with the above work.

The appointments are permanent, superannuable, subject to a medical examination and terminable by one month's notice on either side.

Applications endorsed with the heading of the post applied for, stating qualifications, age and experience, together with the names of two persons to whom reference may be made, should reach the undersigned not later than 1st OCTOBER, 1960.

Canvassing disqualifies.

HERBERT J. MANZONI,
CITY ENGINEER AND SURVEYOR.
CIVIC CENTRE,
BIRMINGHAM, 1.
5th SEPTEMBER, 1960. C 965

ASSISTANT SUPERINTENDENT ENGINEER CUSTOMS AND EXCISE DEPARTMENT

Pensionable post in London for man preferably under 46 to assist in the design, construction, and maintenance of the Customs fleet. Qualifications: Extra First Class Certificate of Competency endorsed for steam and motor; *or* First Class Certificate of Competency endorsed for steam or motor together with an advanced technical qualification in engineering or naval architecture (*e.g.*, degree, H.N.C., A.M.I.Mech.E., A.M.I.Mar.E.). Sound knowledge of design and construction of small vessels and experience of supervising repairs to ships and their machinery essential. Salary scale, £1115-£1375. Excellent promotion prospects.—Write CIVIL SERVICE COMMISSION, 17 NORTH AUDLEY STREET, LONDON, W.1, for application form, quoting S/5198/60. Closing date 3rd NOVEMBER, 1960. C 962

CITY OF LIVERPOOL EDUCATION COMMITTEE COLLEGE OF TECHNOLOGY BYROM STREET, LIVERPOOL, 3

PRINCIPAL: S. A. J. PARSONS, B.Sc.(ECON.), M.I.MECH.E., M.I.PROD.E., M.B.I.M.

Applications are invited for the appointment of HEAD OF THE DEPARTMENT OF ELECTRICAL ENGINEERING (GRADE III). Duties to commence as soon as possible after 1st September, 1960. Salary: £1800 by £50 to £1950 per annum. Applicants must have good teaching, industrial and/or research experience and should possess high academic qualifications.

The person appointed will be expected to develop further the Advanced Courses and Post-Graduate Courses and to encourage research. Work will begin shortly on a building which includes completely new accommodation, laboratories and workshops for the department.

Further particulars and application form (returnable ty 28th September, 1960) from H. S. MAGNAY, M.A., DIRECTOR OF EDUCATION, 14 SIR THOMAS STREET, LIVERPOOL, 1.

THOMAS ALKER,
TOWN CLERK AND CLERK TO THE LOCAL EDUCATION AUTHORITY.
(J.6379). C 942

GOVERNMENT OF HONG KONG ELECTRICAL/MECHANICAL ENGINEER, PUBLIC WORKS DEPARTMENT

Duties comprise the design, estimation, installation, operation and maintenance of air conditioning installations in large buildings including refrigeration plant.

Permanent and pensionable or contract/gratuity appointment. Salary according to experience within the range £1650-£2865. Quarters at low rent. Free passages. Generous leave.

Candidates must be under 45 years and A.M.I.E.E. *or* A.M.I.Mech.E. with at least 3 years' post qualification experience in the refrigeration industry.

Write DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1, giving full names, age, qualifications and experience, quoting BCD 112/51/033/D5. C 955

A MECHANICAL ENGINEER

is required by the

UNITED KINGDOM ATOMIC ENERGY AUTHORITY AT WINDSCALE AND CALDER WORKS, CUMBERLAND

to work in the Engineering Section of the Technical Branch which is studying engineering aspects of reactors, irradiated fuel handling facilities and chemical plants processing irradiated fuel elements. The work requires a practical outlook as it is directly concerned with operating plant, and also a sound theoretical knowledge as radiation problems frequently preclude the use of standard materials of construction and normal testing methods.

Applicants must have served a recognised engineering apprenticeship and be corporate members of the Institution of Mechanical Engineers, or equivalent. A good Honours Degree in Mechanical Engineering may be an advantage and several years' experience on Technical work involving heat transfer and/or stress analysis is highly desirable.

Salary within the scale £1370-£1825 p.a. according to qualifications and experience.

Contributory Superannuation. Staff Housing Scheme.

Send postcard for application form quoting reference P/W.52/J2 to Recruitment Officer, Production Group, U.K.A.E.A., Windscale Works, Seallafield, Seascale, Cumberland.

Closing date, 10th October, 1960.

C 964

CENTRAL ELECTRICITY GENERATING BOARD

ASSISTANT ENGINEERS

Applications are invited for two appointments as ASSISTANT ENGINEERS in the Planning Department at Headquarters. Both will be in the Development Section (Policy) as members of a group which advises on certain technical and economic problems arising from the continuous growth of the electricity supply industry and the increasing capacity of generating stations. The group also contributes to long term studies. An essential in each case is a capacity for forward thinking.

SECOND ASSISTANT ENGINEER

This appointment will be essentially technical administration work and will be mainly, though not exclusively, concerned with the economic data required for forward studies on all types of generating stations, whether coal, oil or nuclear fuelled. The applicant should hold a University degree or similar qualification and should have had experience in the electricity supply or the nuclear industries.

Salary on a scale within the range £1385-£2010 p.a., according to duties and responsibilities.

FOURTH ASSISTANT ENGINEER

This appointment will assist in dealing with problems relating to one or more of the following—Clean Air, Water Resources, Effluent Disposal, Economic Appraisals, Ash Disposal. Experience in one or more of these fields or in the Electricity Supply Industry would be an advantage.

Salary on a scale within the range £930-£1375 p.a. according to duties and responsibilities.

Applications stating age, qualifications, experience, present position and salary to the PERSONNEL OFFICER, 24/30, HOLBORN, LONDON, E.C.1, by 3rd OCTOBER. Envelopes should be marked "CONFIDENTIAL REF. ENG./327."

C 934

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY LECTURER IN FLUID MECHANICS

Applications are invited from engineers or others interested in Fluid Motion and its technical applications. This post, with salary scale £1050 by £50 to £1400 by £75 to £1550 (bar) by £75 to £1850 per annum, plus £60 per annum London Allowance, F.S.S.U. membership and Family Allowances, offers ample opportunity for individual experimental research in a new and well-equipped laboratory. Candidates with practical experience and good honours degree should apply to PROFESSOR C. M. WHITE, IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, LONDON, S.W.7. C 952

TECHNICIAN

MINISTRY OF AVIATION requires TECHNICIAN at ALDERMASTON to assist Proof Officer to study and report on maintenance aspects of all proof equipment at a new proof range. Most of the equipment is of unique design and certain equipments are completely destroyed during proofing, requiring critical study of range economy. QUALIFICATIONS: Recognised engineering apprenticeship. O.N.C., C. & G. Final Certs. or equiv. Knowledge of explosives and of photographic and electronic proof recording equipment. Previous exp. at a proof range undertaking firing proof an advantage. SALARY: £925-£1055. Application forms from MANAGER (P.E. 2829), MINISTRY OF LABOUR, PROFESSIONAL & EXECUTIVE REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4. C 940

INSTRUCTORS

MINISTRY OF AVIATION requires INSTRUCTORS, at FARNBOROUGH, in inspection techniques applied to armoured and transport vehicles and mechanical equipment. QUALIFICATIONS: Recognised engineering apprenticeship. O.N.C., C. & G. Final Certs. or equiv. Previous experience in teaching and demonstrating an advantage. Capable of conducting courses in one or more of following subjects:—practical measurement—welding inspection—engine testing—material testing—tracked and wheeled vehicle driving and inspection—packaging. SALARY: £825 (age 28)-£925. Application forms from MANAGER (P.E. 2832), MINISTRY OF LABOUR, PROFESSIONAL AND EXECUTIVE REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4. C 939

CENTRAL ELECTRICITY GENERATING BOARD

ASSISTANT ENGINEERS

Applications are invited for two appointments as ASSISTANT ENGINEERS in the Planning Department at Headquarters, London, S.E.1. Both will be in the Development Section (Policy) as members of a group dealing with the energy resources available for electricity generation and their economic utilisation in the long term. An essential in each case is a capacity for forward thinking.

SECOND ASSISTANT ENGINEER

This appointment will have special reference to the coal industry and to coal transport. Experience in, or association with, the coal or transport industries of this country will be an advantage. The applicant should hold a university degree or similar qualification.

Salary on a scale within the range £1385-£2010 p.a., according to duties and responsibilities.

FOURTH ASSISTANT ENGINEER

The appointment will be concerned with fuels generally and with the pattern of energy use in the national economy. Experience in the electricity supply industry or in another fuel industry will be an advantage.

Salary on a scale within the range £930-£1375 p.a., according to duties and responsibilities.

Applications stating age, qualifications, experience, present position and salary, to the PERSONNEL OFFICER, 24/30, HOLBORN, LONDON, E.C.1, by 3rd OCTOBER. Envelopes should be marked "CONFIDENTIAL REF. ENG./326." C 933

AUSTRALIA

THE UNIVERSITY OF NEW SOUTH WALES

FOUNDATION CHAIR OF NUCLEAR ENGINEERING

The University invites applications for appointment to the FOUNDATION CHAIR OF NUCLEAR ENGINEERING.

Salary will be not less than £A4263 per annum.

Applicants must have high academic qualifications and experience in some aspect of nuclear engineering. Previous teaching experience is desirable.

The Professor will be head of a post-graduate School of Nuclear Engineering and executive member of the management committee of the Institute of Nuclear Engineering.

He will be responsible for the organisation and conduct of courses in nuclear engineering at post-graduate level and for research work in this field.

Subject to the consent of the Council of the University, Professors may engage in a limited amount of higher consultative work.

Subject to satisfactory medical examination, the successful applicant will be eligible to join the superannuation scheme which provides a maximum pension of £A2184 per annum.

First class ship fares to Sydney of appointee and family will be paid.

Professors are eligible for six months' study leave on full salary after three years of service, or twelve months after six years of service.

The University reserves the right to fill the Chair by invitation.

With the approval of the University and its bankers, married men may be assisted by loans to purchase a home.

Four copies of applications (typed), together with the names of three referees and a recent photograph of the applicant, should be lodged with the AGENT GENERAL FOR NEW SOUTH WALES, 56-57, STRAND, LONDON, W.C.2, and a copy forwarded by airmail in an envelope marked "UNIVERSITY APPOINTMENT" to the BURSAR, THE UNIVERSITY OF NEW SOUTH WALES, BOX 1, POST OFFICE, KENSINGTON, NEW SOUTH WALES, AUSTRALIA, before 31st OCTOBER, 1960. C 970

UNIVERSITY OF QUEENSLAND

SENIOR LECTURER IN ELECTRICAL ENGINEERING

Applications are invited for the above-mentioned position. Applicants must hold an Honours Degree and preferably a higher degree in Electrical Engineering with specialisation in electronics.

The duties will include lectures in advanced circuit and field theory and arrangement of the appropriate practical work.

The salary for a Senior Lecturer is £A2520 to £A2870 per annum.

Further particulars and information as to the method of application should be obtained from the SECRETARY, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36, GORDON SQUARE, LONDON, W.C.1.

Applications close, in Australia and London, on 15th OCTOBER, 1960. C 975

AUSTRALIA

ENGINEERS, METROPOLITAN WATER, SEWERAGE AND DRAINAGE BOARD OF NEW SOUTH WALES

Applications are invited from GRADUATES or DIPLOMATES (preferably under 30 years of age) in Engineering for appointment to the Engineering staff of the Metropolitan Water, Sewerage and Drainage Board of New South Wales. Because of accommodation difficulties, vacancies exist only for single men and married men without children.

Minimum commencing salary £A1250 p.a. for a diplomate and £A1368 p.a. for a graduate, with incremental progression, subject to satisfactory service, to £A2010 p.a. Progression beyond this rate is by appointment as vacancies arise.

The main requirement is for Civil Engineers who have just completed training, but consideration will also be given to those with some experience and to graduates and diplomates in Mechanical, Electrical and Chemical Engineering.

Appointees will be employed on the investigation, design, construction or maintenance of water, sewerage and storm-water drainage projects in the Sydney or Wollongong areas. No country service is involved.

Superannuation Scheme. Good leave conditions. Successful applicants will be nominated for travel under the Assisted Passage Scheme. The cost of the passage is £10 per adult.

For further particulars and application forms, please write to AGENT GENERAL FOR NEW SOUTH WALES, 56, STRAND, LONDON, W.C.2, quoting the number 44/97 in your letter. C 971

MECHANICAL AND ELECTRICAL ENGINEERS

Pensionable posts for men and women normally under 35 on September 1, 1960. Applicants must normally have degree or Dip. Tech. in engineering or physics or have passed examinations necessary for A.M.I.Mech.E., A.M.I.E.E., A.F.R.Ae.Soc., etc. Exceptionally, evidence of high professional attainment acceptable in lieu. Practical training and experience required by untrained graduates acceptable for some posts. Men's starting salary (London) from £830 (lower if under 25) to £1125. Maximum £1300. Promotion prospects.—Write CIVIL SERVICE COMMISSION, 17, NORTH AUDLEY STREET, LONDON, W.1, for application form, quoting S/851/60. Closing date, 13th OCTOBER, 1960. Earlier applicants may be interviewed before that date. C 960

CHEMIST

MINISTRY OF AVIATION requires in London a Chemist, Physicist or Engineer to assist senior officers on safety matters connected with ionising radiation hazards and to inspect establishments. Considerable travelling involved. Qualifications: Hons. degree in chemistry, chemical engineering physics, A.R.I.C., A.M.I.Chem.E., A.I.P., or equivalent, or have served recognised engineering apprenticeship and A.M.I.Mech.E., A.M.I.E.E. or A.M.I.C.E. Knowledge of radioactive materials, apparatus and appropriate safety devices required. Selected candidate will undergo period of training. Salary: £805 (age 25)-£1260. Opportunities for establishment. Forms from Ministry of Labour, Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting reference F.154/OA. Closing date, 29th SEPTEMBER, 1960. C 961

APPOINTMENTS OPEN

TECHNICIAN

MINISTRY OF AVIATION requires TECHNICIAN at HAREFIELD, MIDDLESEX, to assist in setting up hydraulic and pneumatic test facilities in the guided weapon section of a laboratory, and in the subsequent testing, critical examination and reporting of hydraulic and pneumatic components and mechanisms. *Qualifications*: Recognised engineering apprenticeship. O.N.C., C. & G. Final Certificates or equivalent. Conversant with the principles of hydraulics and pneumatics. Practical experience of the manufacture, testing or inspection of such mechanisms an advantage. *Salary*: £975-£1115. Application forms from MANAGER (P.E. 2831), MINISTRY OF LABOUR, PROFESSIONAL AND EXECUTIVE REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4. C 937

MACHINE TOOL DRAUGHTSMAN

An interesting position is offered to an experienced MACHINE TOOL DRAUGHTSMAN. This is an entirely new appointment and demands a man of proven ability. It entails considerable work away from the drawing board, studying machine performances and developing improvements to existing machinery.—Apply in writing, stating age and experience, to: GENERAL MANAGER, COMPOFLEX CO., LTD., HUDDERSFIELD ROAD, OLDHAM. C 976

THE GENERAL ELECTRIC COMPANY LIMITED

ATOMIC ENERGY DIVISION

PRESSURE VESSEL ENGINEERS

Erith & Tokyo

Vacancies exist in the Contracts Department at Erith for Pressure Vessel Engineers for Nuclear Power Station contracts.

Applicants should hold H.N.C. as minimum qualification and should have experience of the design of pressure vessels to the requirements of Lloyd's Register of Shipping and the various codes. Some commercial experience would be an advantage.

The positions are permanent and pensionable.

After a period of service at Erith, Engineers would be considered for vacancies in the Tokyo Office of The British General Electric Company of Japan.

Write for application form in the first instance to the

Personnel Manager (A.N.H.B.),
The General Electric Company Limited,
Erith, Kent.

C959

FIBREGLASS

TRADE MARK

RESEARCH AND DEVELOPMENT

MECHANICAL ENGINEERS

If you have a good honours degree in Mechanical Engineering and would like to hold a responsible job in an expanding industry, you are invited to write about yourself to **Mr. A. de Dani, Manager, Research and Development, Fibreglass Ltd., St. Helens, Lancashire.**

You would be given varied and interesting work on all process and product development on existing plant and design and operation of new plant and processes. Based on St. Helens, you would have occasion to visit works in Glasgow and Birkenhead.

C 953

BABCOCK & WILCOX LIMITED

ATOMIC ENERGY DEPARTMENT

Vacancies exist for

DESIGN ENGINEERS

preferably possessing an engineering degree or equivalent in the Company's Head Office in London:

(1) **PROJECT DESIGN.** Applicants should be capable of original design in the field of mechanical and thermal engineering and should be able to carry out work in the first place on components and later the whole of nuclear steam generating plant.

(2) **HEAT EXCHANGER DESIGN.** Applicants with similar capabilities will work on advanced heat exchangers for gas and water cooled reactors.

(3) **PRESSURE VESSEL DESIGN.** Applicants should be capable of undertaking the design and stress analysis of special pressure vessels of the type used in nuclear power plant.

Write giving details of qualifications and experience to:

The Assistant Secretary,
Babcock & Wilcox, Ltd.
209, Euston Road,
London, N.W.1.

C 951

INDUSTRIAL ENGINEER

AN INTERNATIONAL FOOTWEAR MANUFACTURER and DISTRIBUTOR require the services of an INDUSTRIAL ENGINEER.

Applicants should be capable of preparing drawing board layouts of new factories and extensions to existing factories based on latest methods of material handling and work flow.

The successful applicant would be expected to have a basic knowledge of electric power, lighting distribution and installations; a basic knowledge of methods study and have a plant engineering background.

Some knowledge of the French language would be advantageous.

Location will be in modern offices in Oxford Street, W.1, with the opportunity of occasional visits abroad as work requires.

Good salary with life cover and pension scheme will be offered to the right man. Write in first instance to the PERSONNEL MANAGER, 151, OXFORD STREET, LONDON, W.1. C 948

MALE INDUSTRIAL TRAINING OFFICER

BP has a vacancy for a MALE INDUSTRIAL TRAINING OFFICER at Head Office in the City of London. He will be required to deal with all forms of industrial training, including the organisation of courses. Applicants should be aged about 30 and should have a degree, preferably in Engineering; they should have some experience in their profession, in industrial training and in technical education. They should be knowledgeable about education and apprenticeship in the industrial field. Salary according to qualifications and experience. Non-contributory Pension Fund. Assisted House Purchase Scheme. Removal and settling-in allowances payable in certain cases. Luncheon Club. Write giving full details, quoting reference H.5316, TO BOX 6398 c/o HANWAY HOUSE, CLARE'S PLACE, E.C.2. C 956

Humphreys & Glasgow Ltd

wish to engage a

SENIOR MECHANICAL ENGINEER

for work on major petrochemical projects

Candidates should have had a minimum of ten years' experience. This should preferably cover initial operational or design experience with one of the major refinery or chemical Companies, followed by at least five years in the contracting field on the mechanical design and project engineering of complete plants. In particular, a sound knowledge of fully automatic low temperature gas separation is essential.

This senior appointment, which is permanent and pensionable, carries an attractive salary.

Candidates are requested to send full details of experience to:

Chief Design Engineer,
HUMPHREYS & GLASGOW LIMITED,
22, Carlisle Place,
London, S.W.1.

C974

PILKINGTONS

MECHANICAL ENGINEER

If you have a good honours degree in Mechanical Engineering plus Graduate or Associate Membership of the Institution of Mechanical Engineers and would like to join the Commonwealth's largest glass manufacturing organisation, you are invited to write about yourself to the Personnel Officer (Graduate Recruitment), Pilkington Brothers Limited, St. Helens, Lancashire.

You would be responsible direct to the Works Mechanical Engineer for the installation of new plant and improvement and maintenance of existing plant, including the Pilkington invented "Twin Grinder" licensed to flat glass manufacturers throughout the world. You would find ample scope for initiative and responsibility and there would be opportunity for early promotion within the Group.

The greatest name in the world of GLASS

C 935

DESIGN ENGINEERS

A major oil company requires Chemical and Mechanical Design Engineers for their Oil Refinery in the Middle East. Applicants should preferably have a Degree in Chemical or Mechanical Engineering and should have had several years design experience. Familiarity with the following would be an advantage: liquid and gas pumping equipment, gas engines, steam turbines, heat exchangers, coolers, steam generators and boilers, piping systems, high and low pressure process units together with the necessary calculations of flows, pressure drops, heat transfer factors, etc. Initial salary not less than £1600, plus living allowance, free accommodation, paid home and local leaves, passages paid, pension and provident schemes. Scope for advancement to senior positions and the remuneration provided allows for savings to be made to build up capital. *Reference Number 99*

Please reply in confidence, quoting reference number to:—

Robert Clive (Consultants) Limited

Appointment Consultants

27, ALBEMARLE STREET, LONDON, W.1

C 930

ASSISTANT WORKS MECHANICAL ENGINEER

Iron and Steel

Stewarts and Lloyds, Limited require an Assistant Works Mechanical Engineer for their Iron and Steel Works at Corby, Northamptonshire. A considerable programme of expansion is in hand at this large and fully integrated Iron and Steel Works, and this senior works engineering appointment offers excellent prospects for the right man.

Good engineering qualifications and considerable relevant experience are essential, and a man of between 35 and 45 is most likely to be suitable.

Conditions of employment generally are good and the salary will reflect the age, experience and qualifications of the successful candidate.

Please apply initially, with brief details, to:—

S&L

The Manager/Personnel,
STEWARTS AND LLOYDS, LIMITED,
Corby, Northants.

C 949

PROJECT ENGINEER

A vacancy exists for an ENGINEER to join a small team engaged on project work in connection with improvements and new processes in the seamless steel tube industry.

The work is interesting and varied, and may cover all aspects of a project from initial feasibility trials to the design, installation and commissioning of the final production unit.

The nature of the work is such that absolutely similar experience cannot be expected from candidates, and preference will therefore be given to a man who can demonstrate the qualities of versatility and energy as well as qualifications up to degree standard in mechanical or electrical engineering.

Applications, from men in the age group 28-32, should be addressed to the WORKS DIRECTOR, TUBES LIMITED, KIRBY MUXLOE, NR. LEICESTER, giving brief personal history to date and salary expected. C 926

THE DISTILLERS COMPANY LIMITED

DESIGNER DRAUGHTSMEN

The Company has two vacancies in its Engineering Division in London, W.1. for Designer Draughtsmen. Candidates, in the age range 25/40, should have had experience in industrial and chemical plant lay-out, piping schemes, and pressure vessels. They should have obtained at least the Higher National Certificate (Mechanical). The Company has a non-contributory pension scheme, and other fringe benefits are available.

Write:

STAFF MANAGER
THE DISTILLERS COMPANY LIMITED
21/22 BOLTON STREET
LONDON, W.1

Quote Ref.: 102/60 E.

C 947

AC MACHINE DESIGN ENGINEER

REQUIRED (N.E. ENGLAND)

Experience of design, manufacture and testing of large solid rotor alternators and/or salient pole machines essential. Knowledge of design of exciters and motors a further asset.

Applicant preferably should have an engineering degree but minimum qualifications Grad.I.E.E. or equivalent.

Applications stating age, qualifications, experience and salary required by 22nd September, 1960, latest to BOX C 944, Offices of ENGINEERING.

DRAUGHTSMAN

DRAUGHTSMAN required for work on valve design. Good working conditions, pension scheme etc. All applications will be treated in confidence. Apply in writing to CHIEF ENGINEER, ALLEY & MACLELLAN LTD., BROMYARD ROAD, WORCESTER quoting reference E.G. C 945

SENIOR ENGINEER

Wanted by Paper Mill near Dublin, SENIOR ENGINEER, with at least 20 years' experience of maintenance of heavy plant and installation of new plant on an extensive scale. University Graduate or Member of Institution of Mechanical Engineering preferred. Good salary offered to proved competent hard worker. Apply to BOX C957, Offices of ENGINEERING.

TECHNICAL AUTHOR

TECHNICAL AUTHOR required, not over 50, to assume responsibility for the compilation of operating and maintenance instruction manuals dealing with the Company's machinery. This interesting and progressive pensionable staff position would appeal to a suitably qualified Mechanical Engineer with a bias towards technical writing.—Applications should be addressed to the PERSONNEL MANAGER, MOLINS MACHINE CO., LTD., EVELYN STREET, LONDON, S.E.8. C 973

THE GLACIER METAL CO. LTD.

ENGINEERING MANAGER

Graduate Engineers in their mid to late twenties interested in a career in production engineering management are invited to apply for the post of Unit Engineer. The post carries responsibilities for the work of 15 subordinates engaged in creatively solving the day to day engineering problems of a production unit of 300 people engaged in the manufacture of thin wall bearings on automatic special purpose machines of our own design. The person appointed will be a senior subordinate of the Manager of the Unit.

Salary range, £1100 to £1650, probably starting in the lower end of the bracket.

Apply:
PERSONNEL MANAGER (REF. 2595),
THE GLACIER METAL CO. LTD.,
EALING ROAD, ALPERTON,
WEMBLEY, MIDDX.

C 967

LIBRARIAN

A qualified LIBRARIAN is required to take charge of the Technical Library and Information Bureau of a large engineering works on the North East Coast.

Duties include technical abstracting and the production of a technical information bulletin.

Candidates who have the necessary experience and qualifications should make application stating age and salary required to BOX C 958, Offices of ENGINEERING.

TAYLOR WOODROW CONSTRUCTION LIMITED

due to the development of the
MECHANICAL INSTALLATION DEPARTMENT
require

ESTIMATORS

and

SITE AGENTS

with experience of chemical, refinery and heavy industrial installations.

These are excellent opportunities to join a rapidly expanding department and offer scope for responsibility and advancement to men of ability.

Write to:

PERSONNEL MANAGER
345 RUISLIP ROAD,
SOUTHALL · MIDDLESEX C 980

SENIOR MECHANICAL ENGINEERING DRAUGHTSMEN required for interesting work on large chemical plant installations. Experience in this type of work is desirable but not essential and applicants with general mechanical engineering experience will be favourably considered. The posts offer opportunities and salaries consistent with experience and ability. Modern offices situated in the London E.C.4 area. Five-day week and superannuation scheme.—Applications, which will be treated in the strictest confidence, giving details of age, qualifications and experience, and quoting ref. LCL/E2/67, should be addressed to The Group Personnel Manager, LAPORTE INDUSTRIES LIMITED, HANOVER HOUSE, 14, HANOVER SQUARE, LONDON, W.1. C 969

APPLEBY-FRODINGHAM STEEL COMPANY

SCUNTHORPE, LINCOLNSHIRE

invite applications for a

SENIOR DESIGNER

with experience of heavy

PLATE AND SECTION ROLLING MILLS PLANT.

Permanent situation with interesting and varied work.

Apply, giving age, full particulars of experience, etc., to
THE CHIEF ENGINEER.

C 861

FOR ADVERTISEMENT RATES SEE TRADE & TECHNICAL SECTION PAGE 4

Companies

Continuing Demand for Capital Equipment

TENTATIVELY considering a number of steps towards manufacturing in the European Common Market, the VOKES Company, of Guildford, Surrey, regards the outlook as too complex and undecided for the formulation of any major plan.

Already the group has subsidiaries in Australia, South Africa and Canada, as well as associate companies in India and also in Canada.

Sir Ian Stewart-Richardson, the Vokes chairman, predicts in his annual report that the production capacity of the group will be fully occupied for some months ahead, since the order book is in excellent heart. Further ahead the outlook is not quite so sure as the falling sales in consumer goods are likely to have an effect on the demands from industry for both the group's capital goods and the parts manufactured for supply to other equipment makers. So far there is a continuing demand for capital equipment and initial parts both on the home market and overseas.

The Vokes group profit before tax for the year increased to £536,055. The comparison with the previous year is only partial since the earlier figure, £338,026, is for the nine months up to 31 March, 1959.

Hitching the Profits to a Rocket

Perhaps the most colourful and gay of all the diversification steps taken by British companies is that of the BRITISH MATCH CORPORATION into fireworks.

British Match, who already owned the Bristol Bengal lights and sparkler producers, OCTAVIUS HUNT, have during the past financial year bought JAMES PAIN AND SONS, the Mitcham, Surrey, fireworks and ship's signals manufacturers. As a further move in the broadening of the corporation's interests the Mitcham acquisition is part of the continuing policy which has increased the proportion of the group assets in non-match activities to 22·2 per cent, against 14·3 per cent in the financial year 1958 to 59.

The intense competition in the sale of matches in the United Kingdom is best shown in the seven year table of British made and imported matches sold on the home market.

The total UK sales have been curiously constant, fluctuating around 17·5 million until 1957 and then slipping slightly to 17·2 million last year. Overseas sales of the group are now almost three times their home levels. From 29·8 million gross boxes in 1953 the sales abroad have now reached 32·1 million.

Company chairmen have a habit of being most gloomy when they turn to subsidiaries in Canada. Not so Lord Portal of Hungerford when he reports on the subsidiary EDDY MATCH Company, of Canada, itself a diversified group, whose profit last year improved substantially.

The Australian and New Zealand companies having had a very good year have also some worries about the supply of matchsticks. Aiming at long term self-sufficiency in these supplies popular growing schemes have been started in Victoria and New South Wales.

The home diversification moves include the establishment of a £2,500,000 chipboard factory at Annan, in Scotland, the third of the subsidiary AIRSCREW CO. AND JICWOOD Limited. The corporation is also engaged through subsidiaries in packaging and in wood fibre mouldings, and these too are expanding.

Group profit before tax rose from last year's figure of £2,765,300 to £3,573,746.

Home Match Sales in Million Gross Boxes

	1953	1954	1955	1956	1957	1958	1959
British	12·8	12·0	11·7	11·4	11·3	11·1	11·0
Imports	4·8	5·5	5·8	6·2	6·1	6·2	6·2

Tennessee Valley Authority 27 Years of Age

The Tennessee Valley Authority is 27 years old. From being the *bête noir* of the anti-New Dealers it has now become respectable and a showpiece.

One of the major decisions taken in relation to the Authority is the permission it has now received to market its own bonds. The upper limit is for a total issue of $750 million and it is expected that this will be reached in a few years.

The operations of the Authority are divided into two major categories. The first deal with generating and distributing electric power and are financed from income. The second are non-power activities, such as flood control, improvement of navigation, agriculture and forestry, supported by appropriations from Congress and not expected to pay for themselves. The funds raised by selling bonds are to be used exclusively on the Authority's power programme. The interest on the bonds will be met from revenue from the sale of electric power. This charge is not likely to strain its resources as in 1959 the Authority earned $95·5 million from this source, representing 12·7 per cent on the maximum bond issue now authorised.

The TVA power and transmission system covers 80,000 square miles in the South-eastern states of Tennessee, Alabama, Kentucky, Mississippi and parts of Georgia, Virginia and North Carolina. Since its foundation the generating capacity of the TVA system has multiplied 14 times and now with 11·4 million kilowats of capacity provides 10 per cent of the United States electric supply. Generating costs are low and considerable expansion has taken place since the War. Atomic energy plants which have been set up at Oak Ridge and Paducah are among the Authority's major customers.

Another is the Aluminum Company of America which has moved into the area recently. Some of the individual installations are now famous in their own right. The Kingston generating station, with a capacity of 1,440 kilowatts, is the largest steam-electric generating plant in the world. The Wilson Lock at Shawnee in West Kentucky which has a 100 ft lift is the highest of its kind in the world. The Authority itself is the biggest buyer of coal in the United States, and used over 1½ million tons in 1959. But coal is not the only source of energy. About a third of the power is generated by hydro-electric installations.

Elsewhere the most important work carried out by TVA is in the control of floods. With an annual rainfall of 52 in, the Tennessee River has a great flow of water to cope with. The TVA has built 20 dams at a cost of over $184 million all covered by Federal appropriations. All this activity has brought industry and stability to what was in many ways a problem area. Engineering, chemicals, paper and electrical equipment are among the leading industries. All told the TVA has not only done a good job, it has made regional planning respectable.

Rail-Site Advertising With Decorum

This rail bridge advertising site, more than 100 ft long, carries the direction

of the seventy-company Cementation group in bright scarlet.

The bridge is at a junction of the Great North Road in Doncaster.

Recovery in Activity by Swedish Firms

The current quarterly review of the Swedish bank, SKANDINAVISKA BANKEN, reporting on Swedish company accounts for 1959, records a recovery later in the year. While overall turnover for the larger Swedish companies improved over 1958 by about 6·5 per cent, iron and steel did very much better (12 per cent) and the engineering industry, excluding shipbuilding, increased turnover by 10 per cent.

The Bank's survey of a hundred firms, with a total labour force of 270,000, included only 18 whose sales fell during the year. Five of these were in shipbuilding.

The previous year, as in some other industrialised Western countries, had been one of declining turnover and the recovery shown by the Bank report evidently occurred late in 1959. The general decline of 1958 had missed the engineering industry which, in that year, had stepped up its turnover by 11 per cent, slightly more than in last year.

After increasing by between 7 and 9 per cent in 1956 and 1957, gross profits in 1958 fell back by 2 per cent. Last year they recovered and increased by just over 10 per cent. The result has been an increase of almost 30 per cent in the allocation to investment funds. Depreciation provisions also increased sharply during the year.

Due to changes in the Swedish Government's policy there was a sudden increase in the cash assets held by companies. Cash held by the companies and at the banks rose by almost 50 per cent. Taken together with the improving turnover of the larger companies and their substantially changed liquid assets position, the manufacturing interests of Sweden are apparently well placed to keep themselves provided with the most effective equipment to meet foreign competition in their home market, in the European Free Trade Association and in the rest of the world's markets.

A Steel Company's State Pension Decision

Seventy per cent of the SOUTH DURHAM STEEL & IRON Company's 10,000 employees are to be contracted out of the State Pension scheme.

All the male members of the company's own pension scheme who are earning at least £12 a week are to be contracted out and the company will arrange for all employees whose earnings are less than £12 a week to take part in the national system.

All the company's women employees with sufficiently high wages will join the State scheme, which is to operate from April, 1961.

A Better Future for Braithwaite

Recession conditions in the structural steel industry overtook the Great Bookham, Surrey, firm of BRAITHWAITE & CO. ENGINEERS, during the year which ended this March. The company's West Bromwich, Staffordshire, and Newport, Monmouthshire, works began the year fully engaged but as the then profitable orders were completed it became necessary to accept small contracts, sometimes at uneconomic prices, in order to keep the labour force together.

The financial effect was that the second half of the year severely cut down the profit accumulated earlier. The order book is now being built up again and Mr. J. H. Humphryes, the chairman, anticipates that the production capacity of both West Bromwich and Newport will be fully stretched.

With REED AND MALIK Limited, Braithwaite have been jointly awarded the contract for the prestressed concrete Tasman Bridge, at Hobart, Tasmania. The contract price is £3½ million and the bridge is expected to take about four years to build. Another bridge, also on Braithwaite deep foundations and of prestressed contract is being undertaken with J. & G. MURPHY (CORK) Limited, at Youghal, in Southern Ireland.

For the reasons given by the chairman the group profit for the year before tax fell from £104,922 in the previous year to £49,006.

Print Plant Makers Merging With Printers

Merger negotiations are being conducted between the privately owned printing firm MCCORQUODALE and the industrial group LAMSON INDUSTRIES, who produce office stationery, office machinery components, printing industry equipment and general engineering products.

McCorquodale's, who also control SPOTTISWOODE BALLANTYNE & Company, have large printing contracts with Government departments and with financial institutions.

Automatic Test on Mass Produced Switch

The evolution of large scale production plant has brought with it a need for automatic testing. A device for testing domestic switches makes use of cold cathode triodes.

With the development and increasing use of machines which produce articles in very large quantities, and of large flow-line production plants, a demand has arisen for reliable apparatus which will check the performance, measure, count and generally exercise a control over these machines or plants. In the past, such control equipment has usually embodied mechanical relays which have certain limitations especially when used where dust and vibration are present, and also where fast operating speeds are required, or operation is infrequent. These limitations do not apply to static control equipment.

The General Electric Company has developed a range of static control equipment which makes use of cold cathode triodes, magnetic amplifiers and transistors, either separately or in combination.

A typical application of such equipment using cold cathode triodes, is that employed at the company's Witton Works. The complete unit is shown in Fig. 1. It is a jig, designed and developed by GEC, for individually testing Clipper switches, the latest additions to their Mutac range of domestic switchgear. Having no heated filaments, the triodes used in the unit have a life in excess of 10,000 hours and their use in place of thermionic valves and mechanical relays ensures that the equipment will function accurately for very long periods with a minimum of maintenance.

FOUR TESTS

The device is capable of performing four separate tests on every switch to prove that: (1) the circuit is made with the switch in the closed position, (2) the switch does not break the circuit too early in its travel, (3) the switch does break circuit, and (4) the switch will remake the circuit, and the dolly will return to the " on " position by itself from the point of break.

The switches are tested at normal voltage at 20 per cent over-current, at a rate of approximately one a second. Faulty switches are sorted and distributed to four separate bins and automatically counted. Satisfactory switches are fed to a box in front of the machine. Logic circuits incorporating cold cathode discharge tubes are used for detecting the various types of fault and for initiating the sorting movements, which are then carried out by a pneumatically operated mechanism.

Among the problems of design, there were two which presented great difficulty. The first was that the point at which the switch should break circuit had to be more than 3° from the " at rest " position of the switch dolly when " on." As the dolly rest position was a variable quantity, because of manufacturing tolerances, this required that the datum point for the 3° measurement had to be automatically adjusted for each switch. The second problem arose in the test for re-making from the point of break. This necessitated reversal of the movement of the dolly drive mechanism with negligible overtravel.

MECHANICAL SYSTEM

Figs. 2 and 3 illustrate the mechanical and pneumatic systems adopted in the jig. In Fig. 2, the pivoted lever A takes up a position determined by the switch dolly. The main driving lever B is moved anti-clockwise, pivoting about the fulcrum F_1. Link C is thus moved to the left and by the wedge action, locks lever A relative to the main lever. The whole then rotates anti-clockwise about F_1 operating the switch. The travel of the switch dolly is measured as the movement of platform D from a fixed point. To ensure positive locking of the lever A, the platform movement is restrained by a spring.

In Fig. 3 the switch on test is operated by a lever system driven by a double-acting air cylinder X. To ensure precise position control, the movement of the air cylinder is controlled by a hydraulic piston Y, which forces oil around a closed circuit via a variable valve. A large ratio of movement is obtained by the use of a ramp, E, and roller, and by the length of the arm B which pivots around fulcrum F_1. Current is fed to the switch under test by means of two electrodes carried on a flap G, pivoting around F_2, which is operated by the air cylinder H. After test, the switch is ejected and falls into chute J.

Situated along the length of this chute are four trap doors operated by air cylinders K (the last one is shown open). If a switch is faulty the appropriate trap door is opened by a signal from the electronic circuit, and the switch falls through into the reject bin L. Beneath each trap door is a pivoted platform M, which is struck by the falling switch which then operates a microswitch N, to provide a resetting signal to the air cylinder. A switch which is satisfactory passes unimpeded throughout the length of the chute to a bin O. Other microswitches detect flap position.

LOADING

The switches are loaded by the operator into a channel type magazine, from which they are fed by a weight and pulley system into the testing position in the jig. Once loaded, the jig continues to test, without further attention, until the magazine, which holds 32 switches, is empty. A further batch of switches can be loaded into the magazine while the previous batch is being tested.

The basic element in the static switching equipment used to apply the four sequential tests to the Clipper switches, and to sort the failures into the appropriate bins, is the cold cathode triode tube. This is a small discharge tube containing a neon-argon mixture at low pressure and it has three electrodes: anode, cathode and trigger.

A positive voltage applied to the trigger with respect to the cathode causes a glow discharge between them, which initiates, in the presence of a positive anode to cathode potential, a glow discharge between anode and cathode. This discharge will continue in the absence of any potential on the trigger electrode until the anode volts are considerably reduced.

The method of using the tubes in this application is that of voltage transfer. In this system it is arranged, by means of rectifier gating circuits, that the presence or absence of signals on intermediate tubes controls the passage of signals through the circuit.

CIRCUIT

A basic circuit is used in which groups of tubes are made mutually self extinguishing by the use of a common anode resistor with capacitor, and a series resistor in parallel with the cathode resistor. This means that only one tube in any one group can fire at a time. If another tube in the same group is triggered into conducting, then any other tube which was formerly conducting in that group is automatically extinguished.

Fig. 1 GEC's automatic testing jig for domestic switches.

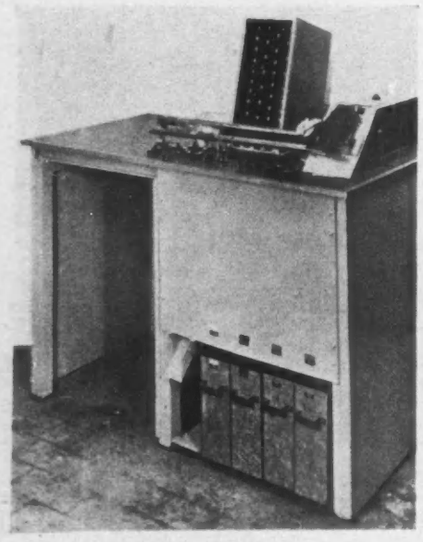


Fig. 2 The mechanism operating the switch dolly under test.

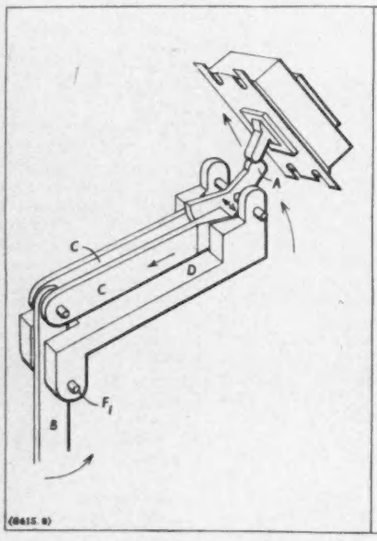
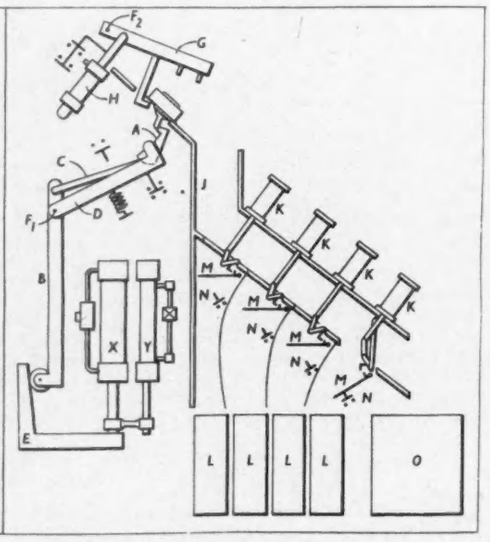
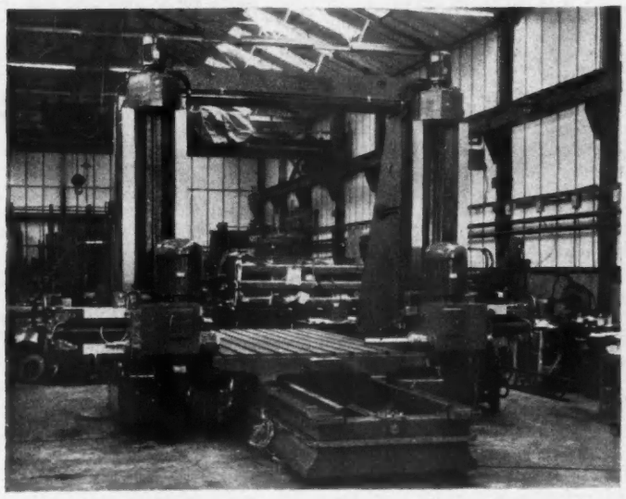


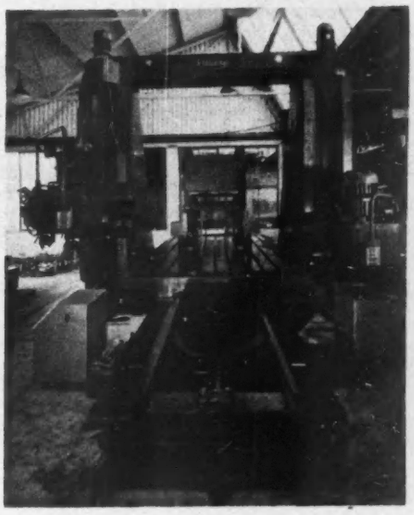
Fig. 3 The pneumatic circuit for the automatic testing jig.





(*Left*) *The horizontal boring machine nearing completion at the Wednesfield factory of Villiers (Tool Developments).*

(*Right*) *The borer installed at the Welwyn Garden City factory of F. E. Weatherill Limited where its function is to bore the steel side members of mechanical shovels.*



Machine Tool Transformation

It took just fourteen weeks for Villiers (Tool Developments) Limited at their Wednesfield factory to convert a 60-year-old horizontal planer into the modern precision horizontal borer shown in the accompanying illustrations. The renovated machine incorporates Villiers unit heads, hydraulic equipment and electronic control apparatus.

The machine was designed and produced for F. E. Weatherill Limited, of Welwyn Garden City, Hertfordshire, to bore the steel side members of their various types of mobile mechanical shovels.

Conversion of an old planer was decided upon because it was felt that the originally intended stress-relieved, mild-steel table and bed would have a tendency to lose machining accuracy through possible distortion.

The table traverse is now powered by a 3 h.p., two-speed electric motor, through a belt drive to a reduction gearbox; the box being mounted on to the base at the rear of the machine, with the output drive coupled to the original lead screw. The reduction gearbox is designed to give a fast or slow table traverse and is operated by a push-button control.

The right and left hand columns are stress-relieved mild-steel fabrications, bolted and dowelled in position. Mounted on to these columns is a left hand and right hand cast-iron V-slide. These carry fine adjustment cross slides on to which are mounted boring quills, each complete unit being suitably counter-balanced. The vertical motion of each unit is carried out independently through a lead screw driven by a 7 h.p. electric motor mounted on a rigidly constructed tie bracket.

The work ends of the quills are driven by two 15 h.p. electric motors, the horizontal feed traverse of the quills being hydraulically controlled using two cylinders, both of which give an 18 in stroke of constant feed required for this type of machine.

Alignment of the boring quills is obtained by a specially designed telescope mounted in the left-hand quill casting, and target pick-ups mounted in the left and right hand quill castings in idential positions. Callibrated scales are positioned along the bed and on the vertical columns for quick setting in the horizontal positions.

The machine is designed for boring holes from 2 in to 9 in in diameter to a depth of 18 in for both quills. The table will travel 15 ft and will bore, for example, a pair of 2 in diameter holes at 14 ft 10 in centres in the horizontal plane from both sides. The quills have a vertical travel of 6 ft 6 in and will bore, say, a pair of 2 in diameter holes at 6 ft 4 in centres in the vertical plane from both sides.

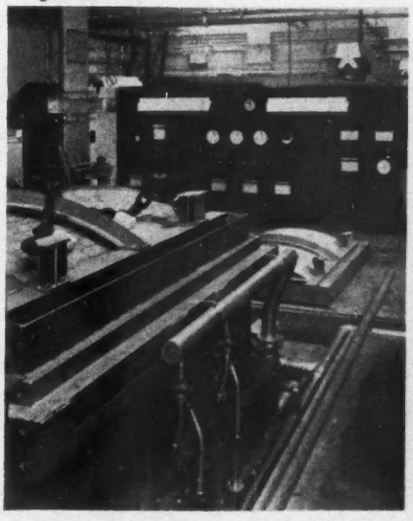
Experimental Forge Furnace

A fully instrumented forge furnace was recently completed in the Energy Section of the British Iron and Steel Research Association at Battersea, London.

The furnace will be used to investigate the thermal efficiencies attainable in batch-type heating processes. It is designed so that the material of construction can be varied, as can the heating schedule, type of fuel and furnace load, re-circulation and waste heat recovery techniques.

The heat capacity of the chamber can be altered by the provision of two alternative roofs, one of fire brick and the other of high temperature insulating brick. Oil or gas firing is provided by means of three burners firing tangentially above the ingot and two below. The effects of convection and radiant heating can be studied.

Comprehensive instrumentation allows calculation of complete heat balances at short intervals throughout the heating cycles. The furnace temperature is measured by means of platinum/platinum rhodium thermocouples, and is indicated and recorded on a Honeywell ElectroniK recorder-controller. Integral in the instrument is a pneumatic control unit which proportions a control signal between 3 and 15 lb per sq. in. The output from this primary controller is applied to the set points of the gas, air and oil-flow controllers. The oil flow is measured by means of a transmitting Rotameter and the flow controlled by a diaphragm valve. Gas and air flows are measured by orifice plates and the pressure drop transmitted by a differential converter to the flow controllers, which operate butterfly valves in the pipelines.



BISRA'S new forge furnace at Battersea.

The primary temperature controller is programmed to give the required heating schedules, the desired preset fuel-air ratio being automatically maintained by the secondary flow controllers.

Over 80 thermocouples are embedded in the furnace walls and 12 are to be found within the three ton ingot. These, together with further thermocouples in the furnace chamber, flues, air ducts, recuperator and stack will be used to calculate the distribution of heat during operation. All these thermocouple readings are continuously recorded on four Honeywell 12 point strip chart recorders, in conjunction with switch gear. A digitising system is applied to two of the temperature recorders so that the bulk of the information is recorded on punched tape to facilitate direct calculation using a Pegasus computer.

In order to minimise the leakage of cold air into the furnace chamber, a pneumatic butterfly valve is fitted in the stack and the pressure held close to a set point by means of a Honeywell pressure controller. The pressure is recorded continuously on an Evershed and Vignoles electric pressure recorder.

The flue gases are continuously analysed. A Cambridge katharamoter with a Honeywell strip chart recorder and an Infra-Red Development Company infra-red analyser are used to estimate carbon dioxide content while a Kent paramagnetic analyser measures the oxygen content of the flue gases.

Vertical Boilers Explode Due to Unexplained Cracks

There is no complete explanation as yet why a number of post-war vertical cross-tube boilers have exploded in recent years. The explosions have resulted from the development of a crack close to the main longitudinal seam, but the origin of the crack is not known.

In 1955 two vertical boilers exploded; three people were killed and 11 injured. In December, 1959, another explosion took place—just as violently, but not causing injury. An account of this explosion and the subsequent testing of similar boilers is given in *Vulcan*, the journal of the Vulcan Boiler and General Insurance Company. The boiler that exploded in 1959 was of the standard vertical cross-tube type, made in 1950 for a safe working pressure of 100 lb per sq. in. A drawing of the boiler is shown alongside. The shell was in one plate $\frac{1}{2}$ in thick, with a double riveted lap longitudinal seam. At a thorough examination on 29 July, 1959, only minor defects were found. These were wasting on the ashplate and uptake, both $\frac{1}{16}$ to $\frac{1}{8}$ in deep and were to be expected in this type of boiler after a few years' service.

The boiler was mounted on a travelling crane and on the day of the explosion had been working in an open yard in the normal way. Fortunately the crane driver had left the crane at the time the explosion took place. Subsequent examination showed that the shell plate failed at the longitudinal seam at the overlap in line with the inner lap edge, and tore along the foundation and crown seams. The force of the explosion projected the boiler about 75 ft when it struck a coal truck and building before coming to rest. There is little doubt that this sequence of events was caused by a similar failure to that causing the 1955 explosions, namely, fracture of the shell plating starting from the inner surface adjacent to the inner lap edge of the longitudinal seam. This fracture had penetrated the plate to very near the full thickness in places and ran for almost the full length of the plate.

The only practical way to detect this type of fault (apart from ultrasonic testing) has proved to be by drill tests from the outside of the boiler, with the centre of the hole in line with the inner lap edge. The position is indicated in the drawing. If no fracture can be seen then a magnetic flaw detector can be applied; use of a permanent magnet and magnetic ink reveals very fine cracks as clear black lines. Since the fractures on the exploded boilers ran for the full length of seam and the greatest depth covered the centre of the length, it is considered that three test holes—one near the top, one near the bottom, and one in the middle—should reveal any fracture.

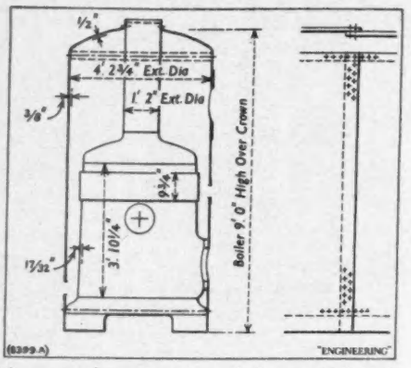
Following the third explosion, Vulcan examined a number of other vertical boilers working under similar conditions to the boilers which exploded, that is, on cranes in the open. Within a few weeks a boiler was found in which a very fine crack had penetrated slightly over half way through the steel plate. It was a stationary boiler, made in 1955. Drill tests of the longitudinal seams of all vertical boilers which have been in service three years or more is now advised. Serious craking has, in fact, been found in a further number of boilers, drill-tested by the Vulcan Company.

The first line of inquiry as to the actual cause of the cracking springs from the familiar fact that internal pressure on a cylindrical shell with a lap-riveted seam produces bending stresses in addition to the normal hoop stress, as the plates, in tending to form a true circle, are prevented from doing so by the overlap. Bending occurs at the lap edge of the seams. Consequently, a high stress is set up in this region, fluctuating with the working pressure of the boiler. The boiler water conditions tend to encourage corrosion and a form of stress corrosion takes place, manifesting itself in the form of wide or narrow grooving.

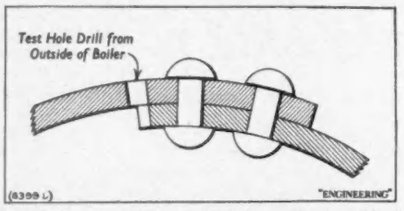
The grooving, progressing slowly over the years, can usually be detected in its early stages by normal inspection, and action can be taken before it reaches serious proportions. Because of this it has caused few explosions.

The same theory may be considered in connection with the recent crack defects that have come to light.

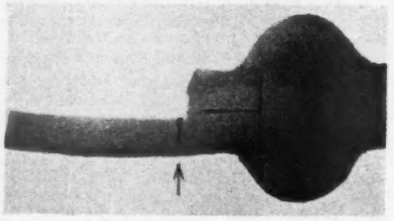
But although a few such defects may have commenced as a normal groove and developed into fine cracks, many appear to be purely and simply fine cracks starting from the inner surface at the lap edge of the seam. And the further question arises as to why it should be post-war boilers that should be the chief sufferers.



The general construction of the vertical boiler which exploded in 1959.



Test holes should be drilled from the outside of the boiler, with the centre of the hole in line with the inner lap edge.



Photograph of a plate section showing crack found by drill test.

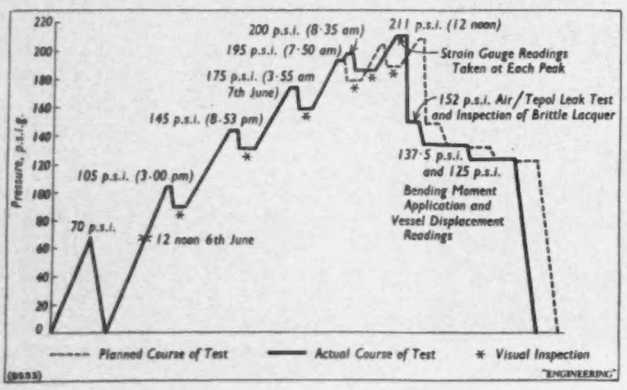
The Biggest Pressure Vessel Test So Far

Examining pressure vessels is a routine operation for Lloyd's Register of Shipping. However, the nuclear power stations present a challenge outside the normal routine. The pressure vessel at Berkeley, for example, was tested to 211 lb per sq. in, and it is almost certain that this was the first time that a vessel of such great volume has been tested to so high a pressure. The Berkeley vessel is a cylinder 50 ft in diameter and 80 ft high, with a domed top and base. It has been calculated that the explosive power contained at full test pressure was equivalent to about 1¾ tons of TNT.

The test was run by a committee composed of representatives of the builders, the purchasers, and Lloyd's Register. It was regarded as a hazardous operation and a security scheme and special safety precautions were adopted. As described in *100A1*, No. 5, there were three main stages in the test. First, the vessel was to be pressurised to 211 lb per sq. in. Second, pressure was to be reduced to 152 lb per sq. in to allow an air/Tepol test to be carried out. Third, pressure was to be reduced to 137·5 lb per sq. in and 125 lb per sq. in for the application of bending moments to selected gas inlet and outlet ducts. During the pressurisation, stress measurements were obtained from 444 resistance strain gauges inside and outside the shell, placed by the Society's surveyors. The builders were responsible for linear measurements showing overall movements of the vessel during the test.

During the week prior to the test, a dummy run was made to 70 lb per sq. in to check instruments and to make sure there were no obvious leaks. A few days before the test started, gas and electric heaters were placed inside the vessel and in the external annulus. Strict control of temperature was important for the satisfactory operation of the strain gauges; and, also, the risk of brittle fracture during the test had to be eliminated. Just before the test the internal heaters were removed, but the external ones remained throughout. The average temperature of the shell remained at 85 to 90° F. Inflow air temperature was controlled by after-coolers.

The first stage of the full pneumatic test was



Pressure within the Berkeley vessel was raised in increments over 24 hours to a maximum of 211 lb per sq. in. The vessel is 50 ft in diameter and 80 ft high, with domes at both top and bottom.

to raise the pressure to 70 lb per sq. in and then depressurise, so that all strain gauges could be initially strain-cycled. At this point full security measures came into force. Site gates were guarded and the site patrolled so that the restricted area was kept clear of people not actively concerned with the tests. During the danger periods—when the reactor vessel pressure was being raised—no one entered or left the reactor building. An alarm system of klaxons, bells, and whistles was set up.

Pressurising was begun on a Saturday. By noon the 70 lb per sq. in mark was reached. At 3 p.m. 105 lb per sq. in was reached and this was held for half an hour, while strain gauge readings were taken, and then reduced by 15 lb per sq. in while a visual inspection was made of the vessel shell.

Before the test was commenced about 550 selected areas of the shell had been coated with plumber's resin. Any local yielding would be shown up by cracking of the resin and, if it developed further, by flaking.

As is shown in the graph, the pressure was then raised in further increments until the peak of 211 lb per sq. in was reached at noon on Sunday. In addition to the repeated strain gauge and visual inspection checks, a surveyor kept a constant watch on about 6 of the most important strain gauges for the whole of the period during which pressure was raised from 175 to 211 lb per sq. in.

When the final strain gauge readings had been taken, the pressure was lowered to 152 lb per sq. in and air/Tepol, or "soapy water," leak tests were carried out. This was desirable because it had not been possible to make radiographic examination of some welded parts of the vessel during construction.

Then followed the bending moment tests and vessel displacement readings. At 137·5 lb per sq. in a bending moment of 72·7 tons-ft was applied to a gas outlet duct and a bending moment of 106·6 tons-ft to a gas inlet duct. At 125 lb per sq. in, the same ducts were subjected to emergency bending moments of 139·5 tons-ft and 209·6 tons-ft respectively. These tests were intended to simulate movements that might result from pressures obtained in the ducts during service.

This concluded the pneumatic test. No yield was detected by visual inspection of the areas treated with plumber's resin. No areas of high local stress were found, and no leaks were discovered in the air/Tepol leak test. A vacuum test was carried out afterwards, and the result was satisfactory. The vessel was therefore passed as suitable for the design pressure of 137·5 lb per sq. in at the design temperature of 340° C.

A few months after, the first reactor vessel at Bradwell was tested. This is spherical, with a mean diameter of 66 ft 9 in, and was successfully tested to 260 lb per sq. in. The second reactors at the two stations have now also been successfully tested.

Air Flow in Fruit Cold Stores

The importance of careful control of the air distribution in cold stores was emphasised by Dr. J. C. Fidler in a paper, "The Construction of Cold Stores for Fresh Fruit and Vegetables," read before the Institute of Refrigeration recently. For the successful storage of fresh fruit and vegetables it is universally agreed that forced circulation of the cooling air is necessary. The stored produce is continually producing heat and this has to be removed by the circulating air, to be given up to the surfaces of a refrigerant-cooled heat exchanger.

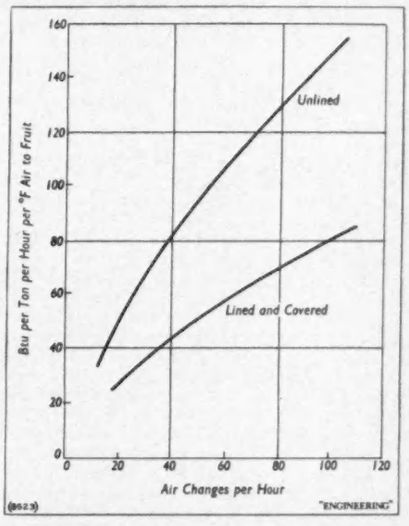
The amount of air circulating is important: too much is expensive in fan power, too little will lead to excessive temperatures in the produce. What is the optimum rate? The illustration shows the effect of air velocity on heat transfer from apples in bushel boxes. In a store at a steady temperature, and the fruit giving off heat at about 40 Btu per ton per hour, the necessary heat exchange may be effected by 40 changes of air per hour, and only about 0·5° F temperature difference between the produce and air.

Dr. Fidler, who is at the Ditton Laboratory, Maidstone, of the Agricultural Research Council, pointed out that fans may with advantage be fitted with two-speed motors, operating at full speed when the refrigerating plant is running, and at half speed when the plant is "off." This will effect a saving in power; it will also reduce heat input to the store and increase the store humidity.

Where the fans are operating continuously at full speed, the power requirements of the fans have been observed to be 65 per cent of the total supplied to the plant.

It helps if the fans are reversible, although the air distribution system is seldom equally efficient in both directions. The main benefit of reversible fans is when first cooling down the produce—temperature gradients may be evened out by periodically reversing air flow. Once the cooling down is over, there is no great advantage in reversing the fans if the arrangements for distributing the air are good.

Although for many years the centrally-sited cooler unit has provided an economic and



Rates of heat transfer from apples in lined and unlined bushel orchard boxes.

efficient solution to the problem of uniform air distribution in stores of up to 8,000 cu. ft capacity, changes in produce handling and loading methods now make it desirable to locate the cooler unit against one wall of the store. This avoids undue manoeuvring and the need to stow evenly around a central obstruction. But location of the unit against one wall brings in a problem of air distribution. Steps must be taken to avoid large gaps and gangways in the stow, to prevent the creation of easy by-pass routes for the airflow.

Experience gained from work at Ditton has shown that the only satisfactory way of obtaining the uniformity desired is by the use of roof air ducts which deliver air to the stack, and with a floor suction plenum from which air is drawn and passed over the cooler. The roof air delivery ducts must be carefully designed to ensure a uniform distribution of air, and the entry to the base of the cooler unit must be of adequate area to prevent restriction of air flow and reduction of fan performance. When the air distribution is bad, fruit from the higher temperature zone will be in a more advanced state and possibly have a greater weight loss.

Flow distribution over the cooler unit is as important as flow distribution in the store itself. In a cooler cited by Dr. Fidler, the fitting of a suitable air deflector and the blocking of the free space at the sides of the unit increased the cooling performance by 58 per cent.

Stopping Jets with Nylon Nets

Nylon nets to stop jet fighters after they have touched down are being installed at 25 French Air Force bases. In a recent demonstration before a group of NATO officers a Mystère IV weighing 7 tons and travelling at 120 knots was brought to a halt in 140 metres after it had itself brought the arresting barrier into play. The deceleration felt by the pilot is said to be less than 2*g*.

The equipment is manufactured by Rolba in conjunction with Aerazur and Aster. It is made up of 28 nets of flat nylon straps that form a barrier 45 metres wide and 4·10 metres high. The brake system, which operates between 2,000 and 12,000 kg, is adjustable from the control tower. Weighing a total of 7 tons, the equipment can be put back in operation 30 minutes after its first operation.

Non-Scheduled Flights Cut at London Airport

Growing density of scheduled flights at London Airport has lead to further curtailment of its use for non-regular flights. Permission for such flights will now only be granted in exceptional cases, when air traffic conditions permit. Single-engined aircraft or recreational flights need not apply.

Permission for non-scheduuled aircraft to use the north terminal aprons between 6 and 11 a.m., and 3 and 7 p.m. will be withheld from 1 May to 30 September, and will only be granted outside these hours if air traffic conditions permit. More severe restrictions will be in force at holiday periods.

Hand Lubrication of High-Speed Testing Track

The high speed track at Pendine, South Wales, has presented certain lubrication problems. It belongs to the War Office's Proof and Experimental Establishment and its parallel rails carry test vehicles at speeds up to 4,000 ft per second. The vehicles run over the 1,000 yard long precision rails on plain metal bearing surfaces.

The whole length of the rails is now treated by hand with a dry film lubricant produced by Acheson Colloids Limited. At first, however, a machine was built to brush the rails and apply the lubricant mechanically. But the flow of lubricant could not be sufficiently controlled. Excessive coating of the rail bull head then occurred, with consequent wastage.

At present, the machine is being used for brushing the rail and the lubricant is applied by hand pads. A maximum thickness of coating of 0·002 in is obtained in this way. The two lengths of rail can be treated in about 2½ hours, drying taking about 10 minutes. Provided the surface is not damaged, the coating has a fairly good resistance to weathering.

Six Litres of Ultrasonic Cleaning

The 500 W ultrasonic cleaning unit developed by Mullard Equipment Limited, with a tank measuring 10 by 8 by 6 in inside, has a capacity of over 6 litres. It can be used as a general purpose cleaning unit. Rocket manufacturers have ordered several for processing gyro mechanisms and hydraulic control gear. Other possible applications include the cleaning of surgical instruments, transistor components, diesel fuel injectors, tools, instrument mechanisms, or jewellery.

Ultrasonic power is supplied by a separate bench-mounted generator. The total energy is distributed between twelve 40 kc/s transducers that completely cover the base of the cleaning tank.

Rounded surfaces of the transducers and the corners of the tank prevent the accumulation of dirt. Any normal cleaning agent can be used.

On the Shelf

By Frank H. Smith

THERE seems to be little chance of the cataract of report literature drying up. The Society of Automotive Engineers has sent an invitation out for papers for their Spring 1961 SAE National Aeronautic Meeting in New York. It was too late if they received the script after 29 August.) In case anybody should be biting the end of his pencil wondering what to write about they offer 31 subject suggestions and a thirty-second which is rather loosely given as "other topics." I do not know how long I have been agitating for a week of prayer for the suppression of report writing but I waded through the entire stock of "On the Shelf" the other night to find what I've said and when I said it. As far as I can see, my first effort was when I quoted a UNESCO *Bulletin* on 3 January, 1958, and supported its plea for a reduction in the number of conferences. On 31 July last, *The Observer* in its feature Table Talk had two long paragraphs which I wish I could reproduce in full but the gist is that the real value of conferences is round the table where the drinks are, or in the pub nearby. It finishes: "There is now a move to introduce a new kind of scientific conference. There would be no formal proceedings at all—except perhaps for a brief opening and closing session. There would be large numbers of bars, comfortable chairs, cafés and quiet corners. . . . The weary interpreters struggling with jargon could go and swim in the lake instead. The libraries would be spared the vast expense of buying volumes of conference proceedings because there would be nothing to publish. Instead—it is confidently predicted—there would be an exchange of scientific information and cementing of professional relationships on an unprecedented scale."

In the European Edition of the *Journal of Commerce* (US) I read of a Mr. Joseph Verbeemen who has invented a revolutionary beer-tap. Its virtue is that it can be dismantled for cleaning by turning a single screw. Dirty taps, it seems, often cause sour beer. Mr. Verbeemen has already invented a bar refrigerator coil that keeps all the beer in Belgium at a steady 5° C and he is now well on the way to producing a motorised cork extractor. It seems to me that Mr. Verbeemen has some sort of complex but he certainly uses his brain to better effect than the Nobels of this world.

Heywood and Company (Carlton House, Great Queen Street, London, WC2) announce a new quarterly, *Cryogenics*, at £5 a year. If you don't know what cryogenics are there's no point in my telling you. The subject leaves me cold.

BP (Britannic House, Finsbury Circus, London, EC2) do an attractive booklet describing their research centre at Sunbury-on-Thames. It is called "B.P. Research Centre" and might help lads to make up their minds what to do with a B.Sc. The lab. man's overalls obviously have been detergentised. With this came the 1959 "Statistical Review of the World Oil Industry" which I have mentioned in previous years as a subject for aperitif-time conversation.

Heffer's (of Cambridge) have a hefty 178 page catalogue 726 on "Secondhand and Antiquarian Books." I do not think one single subject-heading will interest any of you (music, philosophy, archaeology) but I just mention it to show that some people put my mind on a higher level than some of you think.

Now here's a bit of confusion. The latest batch of Interscience leaflets from 250 Fifth Avenue, New York 1 (88-90 Chancery Lane, London, WC2) includes "High Speed Testing." Now is this testing at high speed or is it testing for high speed? The contents list doesn't help an awful lot, either Perhaps there's no difference and I'm being dumb as usual.

Protected and Preserved

Industrial Packaging. By WALTER F. FRIEDMAN and JEROME J. KIPNEES. *Wiley, New York; Chapman and Hall, London.* (92*s*)

At last a book on packaging has appeared which can be read and understood by any competent technologist. It will appeal to a very wide range of people—works managers, transport managers, production engineers, buyers and sales people—who have responsibility for the packaging function in their firms.

The book discusses in simple language some of the main types of container that are available, what their strengths and weaknesses are and what each can reasonably be expected to do. There is sufficient detail and figures to assist the buyer in drawing up his specifications but never so much that the book degenerates into a glorified catalogue. Facts and figures are, where possible, condensed into tables and histograms, and sources of further information are included in the bibliography, which is extensive, as befits a book which has as one of its aims to become a work of reference.

The auxiliary functions of closing, sealing and labelling are discussed and there are good accounts of the many mechanical aids available. Throughout, the book is well illustrated by photographs and clear line diagrams and the authors have managed to explain the language of packaging and yet retain many of the trade terms. Readers in this country may need to make appropriate conversions, for example, basis weights of paper are given as "lb/3,000 sq. ft," that is 500 sheets 24 in by 36 in, whereas the "lb/D.C. 480s" used in this country is equivalent to 2,000 sq. ft.

In producing this volume the authors have set themselves a very large task. Industrial packaging is surely almost as wide as industry itself and it is perhaps not surprising that there are some serious omissions. Corrosion is mentioned, according to the index, on only three pages, two of which contain passing references to corrosion of steel strapping. Surely one of the most important functions in the packaging of many metallic articles is the provision of protection against corrosion in transit and storage. Indeed the whole system of packaging for the armed forces in the United Kingdom is based on the protection which the package affords against corrosion, and the problem is of equal importance in America, where climatic conditions are often severe.

Similarly there is no discussion of shelf-life problems, which stand in the same relation to foodstuffs as corrosion does to engineering products. Since the preface defines industrial packaging as "the function fundamentally concerned with the economical preparation and protection of merchandise for shipment and distribution," it is difficult to see how discussion of the problems arising from the climatic hazards can be omitted justifiably.

Having made decision to omit discussion of corrosion and shelf-life, it is logical that plastics and glass containers should be dismissed in about a dozen pages compared with 150 for paper and board and 60 for wooden boxes and crates. After all plastics and glass have the merit of providing protection against climatic hazards. Again, it is in the field of plastics that some of the most rapid progress in packaging techniques has been made. They are no longer in the novelty class and should surely find a place in any textbook on packaging. Much of the basic information about the properties of plastics and cellulose film is contained in original papers and monographs, which are not read by the men responsible for packaging in industry.

The book is one of a series being published by John Wiley and Sons, Incorporated dealing with all aspects of packaging and materials handling. A companion volume, entitled *Package Design Engineering* by K. Brown has already appeared and was reviewed in ENGINEERING last 3 June). It is to be hoped that before too long another, dealing with some of the omissions of the present volume, will be published. In particular there is need for a book on the consumer aspects of packaging such as, for example, sales appeal, visual merchandising and the correct use and interpretation of market research data.

To sum up, Friedman and Kipnees have made a most useful contribution to packaging literature. There has been a great need for a textbook to serve as basic reading for the educational courses now being organised in this country and in America. The present volume is the nearest approach yet made to such a book. What it does, it does well. Its omissions are understandable but none the less regrettable.

C. H. BULMER

Truck Transport Since the Wheel

Commercial Road Vehicles. By E. L. CORNWELL. *Batsford.* (30*s*)

The commercial road vehicle may appear an uninteresting subject to many people, but when treated in the manner adopted by E. L. Cornwell it becomes as interesting as an historical record and as entertaining as a novel.

Commercial Road Vehicles tells the story of passenger and goods vehicles from horse-drawn carts through the years until the present time. Cornwell touches on several early endeavours to transport materials as far back as 5,000 B.C. and notes that the wheel was first introduced some 3,500 years before the Christian era.

Although it records some interesting early historical information concerning horse-drawn road vehicles up to an including the stage-coach, the book is mainly concerned with self-propelled vehicles, and embraces vehicles propelled by electricity, steam, oil and petrol.

As may be gathered from the chapter headings, the book is devoted to such topics as the historical background, steam road vehicles, petrol road vehicles, electric road vehicles, heavy commercial manufacture, British light commercial vehicle manufacture, coach work, the modern commercial vehicle, goods and passenger services 1935 to 1960, and pattern for the future.

Although the book is largely historical it also contains much technical information, which gives the reader a comprehensive outline of the engineering development that has taken place in bringing the modern road vehicle to its present state.

Descriptions of engines, transmissions and many other items are included, but the reader will find that the author has treated all aspects in such a way as to make easy and enjoyable reading.

The last chapter "Pattern for the Future," goes beyond the present and projects the reader into the foreseeable future, and although some of the developments discussed, for various reasons, may take some time before they are in everyday use, nobody who is interested in road transport vehicles can afford to ignore these possibilities.

The short history of roads in the opening chapter is most interesting and the amount of information provided in a relatively small space is quite remarkable. The author touches on road making, the materials used and the construction of roads through the ages, and the legislative action by various governments to establish responsibility for the provision and maintenance of roads. He also calls attention

to the neglect of roads in Britain following the introduction of railways. Although Mr Cornwell does not mention it, this neglect has continued almost to the present day and has contributed so much to the large number of accidents on the roads.

Distributed through the book are over sixty illustrations of vehicles and about a dozen of components and diagrammatic schemes. These are excellently reproduced, giving a considerable amount of detail, and are of great historical interest.

At the end of chapter three the author mentions the restrictions imposed on the British manufacturer by the British "Construction and Use Regulations" when competing in overseas markets. At the present time there are indications that the British authorities are prepared to change the regulations to reduce this handicap wherever possible.

It is a pity that there is only a passing reference to the commercial vehicle being produced by Napier just before the First World War. It was designed as a commercial vehicle chassis and was virtually the forerunner of the light commercial vehicle and would have compared very favourably with the lightweight vehicles being produced in the late nineteen twenties. The type of frame and general specification were very similar if allowance is made for the improvements to specification which took place with the lapse of time, such as electric lighting and starting equipment, which had become standard in light commercial vehicles by 1930.

It is impossible to convey adequately the wide interest and scope of this book which has been covered so excellently by the author. It can only be suggested that many people with a wide variety of interests would find both enjoyment and information, even if they are not directly interested in commercial road vehicles.

ROLAND R. BISHOP

Hurricane—Focke-Wulf 190—Typhoon

Design for Flight: The Kurt Tank Story. By HEINZ CONRADIS. *Macdonald.* (21*s*)

Kurt Tank was one of the German designers who, though not so well known as Heinkel, Junker and Messerschmitt, nevertheless exercised a profound influence on German aviation. This book is an extremely interesting account of his career. It is, I think, fairly remarkable as a record in detail of conversations and events so far back—a narrative that is perhaps explained by the fact that the author was associated with Tank for many years.

His interest in aeronautical engineering was aroused by the 1922 gliding trials in the Rhone Valley and, although studying for a career in electrical engineering, he decided to start with the Rohrbach Company; consequently much of the book describes his work on the Rohrbach series of flying boats and large aircraft.

Quite early in his career Tank decided that a designer must be a pilot and accordingly he learnt to fly, taking an aerobatic course, so it is not surprising that much of the book deals with incidents while he was acting as a pilot. Kurt Tank must, in this respect, be almost unique, but not everyone would agree that a designer could or should be a good test pilot.

He stayed with Rohrbach until 1929, joined Messerschmitt for a short time and finally the Focke-Wulf Company in November, 1931. It is that part of the book dealing with his work with this company, particularly after the Nazis came to power in 1933, which will be of extreme interest to the aeronautical community in this country.

The rate of growth of the German aircraft industry from 1933 to the outbreak of war has always seemed remarkable, but from this book one can see how the various phases of aeronautical engineering were being extensively developed during the entire period between the two wars.

The difficulty of foreseeing future development in aviation is illustrated by the statement, attributed to the Master of Sempill in 1928, that the future lay with biplanes and the German Air Ministry's reluctance to consider a fighter aircraft proposed by Tank, which was a monoplane, shortly afterwards. To some of us in the industry it was then obvious that further improvements in performance could only be achieved by a drastic reduction in drag and by 1933 the basic design of the machine which became the Hurricane had been submitted to our Air Ministry by the reviewer.

The chapters headed "Faster and Faster" and "Research versus Production" describe the difficulties of a designer, and also emphasise the advanced state of knowledge in Germany prior to the war. They had given considerable attention to flutter and compressibility phenomena, this leading to the swept back wing proposed by Professor Betz at Göttingen University. There is no doubt that technical progress in Germany during this period was extremely rapid and, one is inclined to think, more advanced than ours.

Both the German Air Ministry and the Focke-Wulf company considered that the utmost consideration must be given to high performance, and a series of fighter aircraft were produced, culminating in the FW.190 which caused such concern when it appeared on the Western Front in 1941, as it was undoubtedly superior in speed and climb to the Spitfire and Hurricane. We must, however, recall that the Hurricane, the first monoplane fighter delivered to Fighter Command, first flew in 1935.

The FW.190 possessed a number of interesting features. Probably the most important change was that it was fitted with a large radial air-cooled engine of about 1,600 h.p.—a reversion to the view that fighters must have air-cooled engines, which had given way to the long run of liquid-cooled engines, starting with the Rolls-Royce Kestrel engine in 1926.

Another interesting feature of the FW.190 was the persistent use of synchronised guns, a feature long since discarded in Royal Air Force fighters and which undoubtedly slowed the rate of fire. The great structural strength of the Hurricane and Typhoon wings permitted heavy gun armament to be mounted outboard of the propeller arc. Some of the performance superiority achieved by the FW.190 in its early months was due to the lighter armament and armour protection.

Our answer was the Hawker Typhoon, the design of which was submitted to our own Air Ministry in the spring of 1937. It centered round the new Napier Sabre liquid-cooled sleeve-valve engine of approximately 1,900 h.p. and was intended to carry much heavier armament than the Hurricane, which had then been in service for a year or so. Generally, the specification finally issued for the Typhoon must have been very similar to that for the FW.190 and it is interesting that both entered service at the same time. The armament of the Typhoon, however, was four 20 mm cannons, whereas the FW.190 at that time only carried four 7·9 mm guns. It was thus far lighter armed than the Spitfire and Hurricane, the former with two cannons and four machine guns, and the Hurricane with four 20 mm cannons.

The Typhoon was finally employed in the ground-attack role and in this capacity was more than a match for the FW.190. Later, with a 2,400 h.p. Bristol Centaurus air-cooled radial engine, and called the Tempest, it achieved a top speed approaching 450 m.p.h.

But it was obvious then that we had reached the limit of development with piston engines and airscrews but, could we have foreseen that within five or six years the speed of 460 to 470 m.p.h. obtained with the Tempest VI, and which was so painstakingly reached, would be advanced to 600 m.p.h. by 1946 and to the 730 m.p.h. of the Hunter in 1951.

One point which will impress the reader is the insistance by Tank that Germany should build fighters rather than bombers and one wonders, if this had been acted on, whether the war would have finished as it did.

The account of his visits to England after the war are interesting, but one must query the statement made after a visit to Fairey in which he concludes that English drawing-office practice left a good deal to the initiative of the men building the prototype, whereas in Germany everything was drawn out in detail.

The book also gives an account of his work designing aircraft under President Peron in the Argentine and then in India, and concludes with an appendix giving his reason for the defeat of the German Luftwaffe, the first paragraph stating, "The lack of a Combined Services Staff consisting of the leaders of science and industry as well as of the Service chiefs", and a most interesting chapter detailing the history of all the aircraft developed under his direction.

To the writer the chief thought left after reading the book is the tremendous difficulty of planning future development in aviation and the importance of keeping any such programme as flexible as possible.

SIR SYDNEY CAMM

Efficient Fabrication by Courtesy of the Designer

High Productivity in Heavy Engineering. By A. G. THOMPSON. *Iliffe.* (65*s*)

So often today new technical books are only a rehash of previous books on the same subject, but this criticism is not true of the present publication. This book is certainly something different. The choice of subjects treated is original, and the overall presentation of them is also new. All topics are dealt with in a straightforward manner, and anyone with some knowledge of heavy engineering fabrication will find the contents easy to read and comprehend.

The book is not likely to be used as a reference book, since it is really an introduction to the whole field of high productivity in heavy engineering. As such it should be of considerable value to students, draughtsmen, junior engineers and junior managers; it should also be of interest and value to shop personnel. Senior management and engineering staff will find that the book does not go far enough; this is not a weakness but rather an inevitable limitation of the book.

The first two chapters comprise a very brief introduction to the fundamentals of welding fabrication, together with an equally brief, but adequate, outline of the principles of layout and organisation in a modern fabrication shop. The book is concerned with heavy fabrications, in both shipbuilding and large pressure-vessel construction, although generally the subject matter is more often applicable to the former than the latter. The chapter relating to accurate fabrication is, for example, more concerned with shipbuilding, but it provides a lesson of great importance in both applications; the reflections

of plate inaccuracies upon weld details and cost is well explained. The so-called typical practical limits referred to of $\frac{1}{16}$ in per 10 ft can be misleading in pressure-vessel construction since these tolerances are far stricter than necessary for pressure vessels. For example, final tolerances for out of roundness in a pressure vessel are generally 0·4 per cent and the tolerance on circumference of 0·25 per cent, although other dimensions need of course to be more accurately maintained. It should also be remembered that the accuracies required have not only to be balanced against cost but also that the accuracy need not be greater than that required to produce a finished article which will be satisfactory in service.

The section dealing with metalworking processes is very good, and very well illustrated, the only criticism being that the introduction of mathematics in connection with plate bend rolls is a little out of place and serves no real purpose since it is over simplified. The brief chapter on assembly is nicely compiled, and although that on welding processes covers only the basic fundamentals, it does conform to the stated aims of the author in that respect.

Quality control and inspection are discussed, but no reference is made to the necessity to analyse this chemical composition of both the parent plate material and the weld metal. Also, pressure-vessel fabricators would like to see reference made to the different inspection standards applicable to the different classes of vessels.

Costs are fully considered both from the aspect of assessing them and, more important, with regard to the way in which these costs can be utilised. The discussion of costs is valuable since once again it is the fundamentals which are explained, and they will apply irrespective of whether the jobs concerned involve one-off or batch production.

The last section deals with productivity improvement, and in this section it is felt that more attention should be drawn to the importance of design in productivity. Productivity and design are inseparable and must go hand in hand; it should be the constant aim of designers to produce designs which may be economically produced by the plant available and furthermore, when output is at a maximum, it may be worthwhile to amend designs so as to utilise fully all plant available.

The overall production of the book is satisfactory and the suggested list of material for further reading at the end of each chapter is a good feature. Unfortunately, the book will probably be regarded as expensive by those likely to achieve most benefit from it.

P. J. PALMER

New Books

The Numerical Treatment of Differential Equations. By LOTHAR COLLATZ. 3rd Edition. *Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf.* (98 *DM*)

The aim of the author has been to provide a summary of the general methods of solution, illustrated by numerous worked examples.

Colliery Year Book and Coal Trades Directory, 1960. 38th edition. *Iliffe.* (40*s*)

Comprehensive coverage of the coal industry, with details of organisations, mines, a directory of the coal trades, a who's who of the industry, surveys of the US and European mines, statistical tables, a buyers' guide to equipment, and a list of mines and quarries regulations with the latest amendments.

Technical Communication. By GEORGE C. HARWELL. *Macmillan, New York and London.* (26*s*)

Written primarily with the engineering student in mind, this textbook on good writing in letters, reports, articles and speeches will be of equal value to practising engineers and others engaged in technical fields.

The Control of Monopoly in the United Kingdom. By PAUL H. GUENAULT and J. M. JACKSON. *Longmans.* (25*s*)

The authors begin their work with a brief account of the problems of control and of the attitude of various sections of the British community towards monopoly, and then proceed to a more detailed analysis of the 1948 Monopolies and Restrictive Practices Act, and of a group of reports by the Monpolies Commission.

Handbook for Chemical Society Authors. Special Publication No. 14. *Chemical Society, Burlington House, London, W1.* (21*s*)

Although intended for contributors to the Society's publications, this is an outline of style and an extended guide to nomenclature, according to IUPAC rules and symbols, which deserves a wide dissemination in the interests of the accurate and intelligible flow of information between scientists and technologists.

An Introduction to the Theory of Aircraft Structures. By D. WILLIAMS. *Edward Arnold.* (60*s*)

The aim in this book is to provide a background for the solution of aircraft structural problems as distinct from providing a collection of solutions to particular problems. An attempt has been made to make the book largely self-contained: only a knowledge of the elementary theory of beams is assumed.

Colour in Industry Today. By ROBERT F. WILSON. *Allen and Unwin.* (35*s*)

An approach to the industrial use of colour, introduced by a consideration of the science, physiology and psychology of colour, and continuing with the function and practice of colour in offices, factories and hospitals.

The American Civil Engineer. By DANIEL HOVEY CALHOUN. *The Technology Press, Massachusetts Institute of Technology, Distributed by Harvard University Press, Cambridge, Massachusetts; Oxford University Press, London.* (44*s*)

When the United States developed a need for civil engineers, in the early nineteenth century, there were conflicting ideas about the best professional qualifications. Mr. Calhoun considers the careers of engineers from the end of the eighteenth century to the middle of the nineteenth, and discusses their tasks, the creation of a pool of technicians, and the profession's historical growth.

Accounting and Tax Aspects of Patents and Research. By J. A. MCFADDEN and C. D. TUSKA. *Van Nostrand Company, Princeton, New Jersey, and London.* (56*s* 6*d*)

Here are up-to-date answers to accounting and tax questions relating to the research and development process of patentable inventions in the United States, with reference to current tax practice and court decisions.

Broaching. By C. MONDAY. *Machinery Publishing Co. Ltd.* (18*s* 6*d*)

A new addition to the *Standard Reference Series*, dealing with a process which has undergone considerable development during recent years, and now ranks as a major production process. Much of the book consists of examples taken from current practice in both continuous flow and medium-lot production.

Men and Molecules. By CARL R. THEILER. *George Harrap.* (21*s*)

A popular introduction to the course of chemical discovery and the application of scientific research to the practice of the chemical industry, written by a distinguished Swiss chemist.

Concentration in British Industry. By RICHARD EVELY and I. M. D. LITTLE. *Cambridge University Press.* (55*s*)

The relative importance of the largest firms in an industry is often expressed by a concentration-ratio giving their combined share of the total output or employment of the industry. Such ratios provide a starting point for the analysis of different industries, and the present volume utilises them in studying almost the whole range of British industry in the period 1935-51.

Occupational Information: Its Development and Application. By CARROLL L. SHARTLE. 3rd Edition. *Prentice-Hall, Englewood Cliffs, New Jersey, and London.* (58*s* 6*d*)

Occupational information is essentially a description of a man's work and its related conditions. This book was written to meet the need for an introduction to the development of occupational information and a description of the uses of such information in problems in industry, government, education, and social work.

Mechanics of Materials. By ARCHIE HIGDON, EDWARD H. OHLSEN and WILLIAM B. STILES. *Wiley, New York; Chapman and Hall, London.* (62*s*)

This book is designed for a first course in mechanics of materials, and the major emphasis is placed on the elastic range of stress. Where feasible, the presentation is extended to include the analysis of the plastic range, with appropriate problems.

Motor Transport Cost Tables and Fuel Consumption Cost Reckoner, 1960. *Iliffe.* (2*s* 6*d*)

The tables give the latest costs of running all types of goods vehicles, including variations in drivers' wages and the cost of petrol and diesel fuel.

Alternating Current Machines. By H. COTTON. 2nd Edition. *Cleaver-Hume Press.* (21*s*)

The new edition of Professor Cotton's account of alternating current machinery introduces mks units, reference to relevant British Standards, and a section on the choice of motors to suit given conditions.

The Reviewers

Mr. C. H. Bulmer, M.A.(Cantab.), is a member of the packaging research staff in the Printing, Packaging and Allied Trades Research Association and a member of the Institute of Packaging.

Mr. Roland R. Bishop, M.I.Mech.E., has recently retired from Vauxhall Motors Limited, where he was commercial vehicle engineer. Previously, he had been chief draughtsman with the same company and with Bentley Motors Limited. From 1929 to 1930 he served with Associated Transmissions Limited as chief designer in the development of the Barrington inertia gear for use in road vehicles and the Humphrey Sandberg free wheel, and earlier had worked with G. Constantinesco, on carburettors, W. H. Dorman and Sons, the Admiralty and D. Napier and Sons.

Sir Sydney Camm, Kt., C.B.E., F.R.Ae.S., is director and chief engineer of Hawker Aircraft Limited. As one of Britain's foremost designers he has been responsible for a long range of fighter aircraft, beginning with the famous pre-war Hart, and including the Hawker Hurricane which, flown by The Few, helped to win the Battle of Britain. Later he designed the Typhoon, the Tempest, and more recently, the eminently successful Hawker Hunter. He is also the designer of the new Hawker P1127 vertical take-off close-support fighter aircraft, which is now ready to make its first flight.

Dr. P. J. Palmer, M.Sc., Ph.D., A.R.C.S., D.I.C., A.F.R.Ae.S., A.Inst.P., Mem.A.S.M.E., is chief engineer of John Thompson (Wolverhampton), Limited.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Drive Belt. TURNERS ASBESTOS CO. LTD., Rochdale. Poly-V belt drives claimed to be more efficient than conventional V belts. Description, ratings and stock sizes listed in a 26 page illustrated catalogue.

Carburettors. AMAL LTD., Holdford Road, Witton, Birmingham 6. Carburettors, fuel pumps, and spares for agricultural, stationary and marine engines. Various leaflets.

Angle Drives. VARATIO-STRATELINE GEARS LTD., 277 Aberdeen Avenue, Trading Estate, Slough, Bucks. Right angle drives using bevel gears; single or T units in 16 stock sizes and types. Characteristics given in folder.

Diesel Engines. F. PERKINS LTD., Peterborough. Handbook on the selection and installation of marine diesel engines made by the firm. 50 pages including dimensions and performance curves for all types.

Marketing

Remington to Expand Scottish Output

REPORTS in New York that the REMINGTON division of the SPERRY RAND CORPORATION is to move its standard and portable typewriter production overseas by early next year arouse speculation about increased activity at the Remington factory on the Hillington Scottish Industrial Estate.

An official of the subsidiary has said that while it was not known if the whole of the New York works production would be transferred to Hillington some at least would be moved there.

Only last month equipment was installed in the Scottish factory's 131,000 sq. ft extension. The full range of Remington typewriters are made at Hillington. At present some 76 per cent of the company's output is being exported to more than 80 countries.

Reclaiming Land with Lightweight Tractors

The green pastureland of Eridge Castle Park, Sussex, where cattle and sheep have replaced the bracken and rocks of three years ago, are an example of what can be done with lightweight wheeled tractors.

When the work of reclaiming the land began in early 1957 it was intended to plough and put to productive use 100 acres a year. In fact, 330 acres were ploughed in the first 16 months. There are now 255 acres of autumn cereals, 115 acres of this year's grass and 33 acres of second year grass.

Three diesel engined MASSEY-FERGUSON M-F35 tractors have been in use on the job, joined in the second year of the work by an M-F65. Eridge Castle is the home of the Marquess of Abergavenny.

Declining US Machine Tool Orders

The order book of the United States machine tool industry, as good a guide to North American prospects as the home machine tool trade for the United Kingdom, fell in July to the lowest total of new orders since January, 1959.

New orders for all types of machine tools in July were worth $42 million; a month earlier there had been $55 million worth of new orders while a year ago, July, 1959, the month's new orders had reached $63,400,000. The decline in foreign and home orders differed in the sections affected, according to the report of the National Machine Tool Builders Association. Within the United States orders for forming tools took the brunt of the fall. Abroad there was a falling demand for metal cutting tools.

As the result of the higher levels of activity, from which there now appears to be a decline, the July shipment of machine tools was greater than a year ago, almost $52 million against approaching $41 million.

While earlier in the year the industry had a five months backlog of orders, this is now down to 3·9 months.

Congo Management Company's Agreement

Publication of the details of the agreement signed by Mr. Lumumba, the Congo Prime Minister, and Mr. E. Detwiler, the United States financier president of the CONGO INTERNATIONAL MANAGEMENT CORPORATION (CIMCO), in July for the exclusive development of mineral and hydro-electric resources shows that operations are to be through a subsidiary company, owned jointly with the Congo Government.

The agreement, which is for 50 years, lays it down that CIMCO shall spend at least $1 million a year throughout the period, profits are to be equally divided over the period of the agreement and until the capital and interest of the first investment has been fully refunded. From then on the assets and all the profits will be Congolese.

The subsidiary, the SOCIETE CONGOLAISE DE GESTION ET DE DEVELOPPEMENT, was, by the terms of the agreement, to be prepared to begin operations in 90 days. It is to have a capital of just over £700,000 in equal numbers of A and B 50 franc shares. The A shares are those for the Government, to be held without payment, the B stock being subscribed for by CIMCO.

The agreement, which specifies an area with a maximum extent of about 38,000 square miles, protects the company against nationalisation, in that the Congo Government agreed to put through legislation to that effect. It also provides for diplomatic immunity for the company's expatriate employees, enables CIMCO to take up and relinquish concessions at its own decision and guarantees freedom of exchange remittances.

Cuban Aid to British Guiana

Dr. Fidel Castro's Cuban Government are to lend $5 million (£1·8 million) to British Guiana for the development there of the timber industry.

Cuba is also to buy some of British Guiana's rice crop. A technical aid exchange scheme is being set up between the two countries with a first aim of assisting agriculture and particularly tobacco growing in British Guiana.

Falling Sales Cut Renault Production

Explaining that seasonal fluctuations in sales were the cause, the French RENAULT car company has cut the working week of half its labour force, some 30,000, by three hours. The cut is from 48 to 45 hours but the men concerned will receive half pay for the three lost hours.

As with the car firms in other countries, the exports of the French industry to the United States are known to have fallen back since the full impact has made itself felt of the Detroit-built compact cars. As yet no other French motor concern has followed the Renault step.

If to British experience the half pay for the hours no longer to be worked appears generous, that is not the way it is seen in France. The local trades unions have complained at this treatment and are demanding full pay instead.

Rules for Lorry Crane Association

The rules of membership of the LORRY MOUNTED CRANE ASSOCIATION, which was formed at the end of last year, have now been established by the inaugural committee.

The association was formed with the aims of guaranteeing minimum standards of safety reliability and insurance. It is also intended to try to bring about the rationalisation of the existing legislation relating to lorry mounted cranes, to establish a minimum set of contract conditions and to promote high standards in heavy lifting practice.

Such cranes are at present covered by a number of regulations, some dating from before the development of this equipment. Local bye-laws, police regulations, dock rules, Factories Acts, Mines and Quarries Acts and building and civil engineering regulations all apply at one stage or another to the owners, drivers and operators.

One of the first acts of the association has been to draw up a standard form of minimum insurance cover. This must be complied with by members although individual firms already arrange additional forms of cover.

The LMCA is in no way concerned with the fixing of charges for the hire of lorry mounted cranes. Each mounted crane owned by a member firm is registered with the association and must carry the certificate of an approved inspector reporting its safe mechanical condition. An inspection report has to be produced yearly.

A lorry mounted crane is defined by the association as a crane mounted on a vehicle with a minimum of six load carrying tyres and designed for road speed above 15 miles an hour. The crane's maximum safe working load must be not less than 3 tons and its minimum slewing angle 30°.

Headquarters of the LMCA are at 301 Glossop Road, Sheffield 10.

South Africa's Exports Improving

Exports from South Africa were at the highest level they have yet reached in the first half of this year. Although the favourable trade balance was considerably more than wiped out by the withdrawal of capital after the racial incidents, the import-export position of South Africa, allowing for invisible earnings is shown to be good.

The value of exports between January and July was £418 million, including gold worth £154 million.

AEI Telecommunications Contract for Indian Project

MURPHY RADIO, of Welwyn Garden City, have ordered carrier transmission equipment worth £130,000 from ASSOCIATED ELECTRICAL INDUSTRIES' telecommunications division transmission department. The equipment is for radio network in the 720 mile Oil India pipeline project in Northern India.

The radio system is needed to provide the headquarters of OIL INDIA PRIVATE Limited with telemetering facilities in order to bring about a constant check on oil flow along the pipeline from the issuing station to the refinery.

The AEI multi-channel system, with a final terminal capacity of 34 channels for telemetering and teleprinter facilities and for speech facilities, conforms to the international standards recommended by the Comite Consultatif International Telephonie et Telegraphie.

Electric Watches at Jewellery Fair

INGERSOLL, as the sole United Kingdom representatives of the HAMILTON WATCH Company, Pennsylvania, USA, and LOUIS NEWMARK, agents in Britain for AVIA, of Switzerland, have been showing electric watches at the Watch and Jewellery Fair, Olympia.

The two Avia models, selling at between £40 and £50 are of stainless steel and rolled gold. The Hamilton watches, which first went into the shops in the United States three years ago, have a wider price range, between £50 for a stainless steel type up to £150 for one in 18 carat gold.

For the electric watches it is claimed that accuracy is greater and that it is less likely to suffer serious damage. The smaller-than-a-farthing cell that powers the Hamilton watches can be changed, after about a year's duty, in a matter of minutes.

Widening Swedish Trading Gap

Sweden's foreign trade deficit in the first half of 1960 was more than double that of the same period of last year. The figures were 1960's first half deficit, Kronen 1,012 million (£70 million)—1959 first half, Kr 402 million.

The national import bill rose by more than 50 per cent more than the increase in export earnings. The deficit in the June account being slightly less than that in May but more than three times that of last June.

Oil imports, rubber, textile fibres, ores and scrap iron all increased in value. Iron and steel imports rose from 387,000 tons to 609,000 tons. Car imports increased by a few thousand to 67,942 while car exports were up almost 25 per cent to 34,016. One-third of the increased value of exports came from raw materials.

Engineering employment in Sweden rose sharply during the summer, according to the latest Swedish-International Press Bureau report. The Bureau measure this by hours worked per week and finds that the total increased in June by 2·5 per cent over May. The June number of hours worked was 8 per cent greater than in June of 1959.

Bristol Buys Rotary Wing Operator

OKANAGAN HELICOPTERS Limited, the largest commercial rotary wing operators in the world, are to be purchased by BRISTOL AERO INDUSTRIES Limited, for $4,061,589.

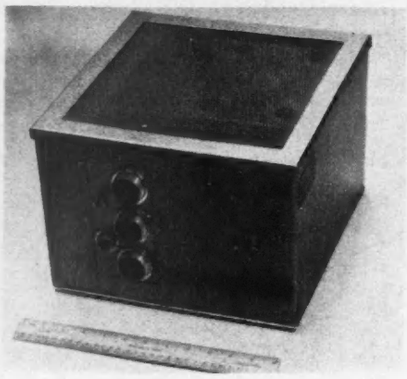
The Okanagan shareholders have given their permission for the sale. The permission is now needed of the United States Department of Transport and the Air Transport Board.

Telemetering for Bluebird

In Bluebird's attempts on the World Speed Record stress variations in the engine and suspension are recorded at a remote observation post for future analysis. If dangerous conditions arise Campbell can be warned by radio.

By A. D. Runnals,

Electronics Division,
Sir W. G. Armstrong Whitworth
Aircraft Limited

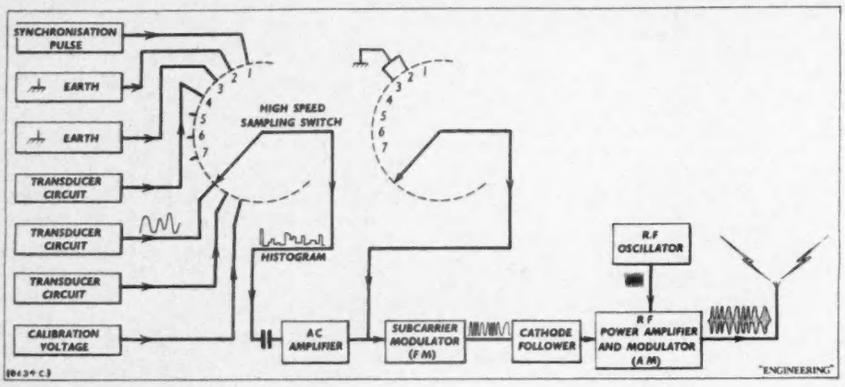


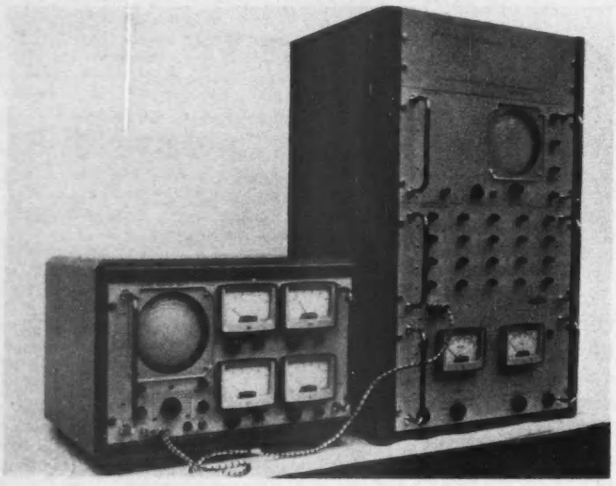
During an attempt on the world's land speed record many of the car's components are severely stressed. So that these stresses may be observed and later evaluated, Bluebird is fitted with analogue telemetry equipment associated with 18 selected vital points. This equipment was chosen in preference to a recording camera on the car that photographs the readings for subsequent analysis, since this latter type of equipment suffers the disadvantage that the results are inaccessible until completion of a run.

Bluebird's system is a novel application of the well-known DIDAS (Dynamic Instrumentation Data Automobile System), developed by Sir W. G. Armstrong Whitworth Aircraft Limited, Baginton, Coventry, and normally used for automobile testing. Essentially it comprises three main items of equipment, a multi-channel transmitter on the car, and receiving and demultiplexing equipment at a fixed station. The purpose of the latter is to "unscramble," display and record the individual readings.

The transmitter works in conjunction with a number of transducers on Bluebird, while the receiving and demultiplexing equipment is contained in a Land Rover used as an observation station and positioned at one end of the track. Apart from being observed by various vehicle component manufacturers' technicians, the information received can be relayed to Donald Campbell by means of a two-way VHF radio link. The readings telemetered through the 24-channel system are given in the table below.

The majority of the transducers are by Smiths Electrical Instruments Limited, and each is connected directly to the transmitter unit.

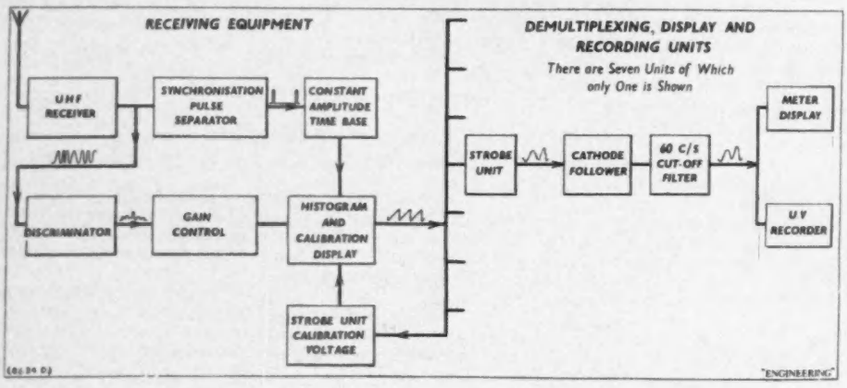




Figs. 1 and 2 Fig. 1 (above) shows an outline of the transmitter unit. Fig. 2 (beneath) is a block diagram of the transmitter unit.

Fig. 3 (left) Telemeter receiving and demultiplexing equipment.

Fig. 4 (below) Block diagram of the receiving equipment.



Channel No.	*Purpose or reading*
1	Synchronising pulse
2	Earth
3	Earth (d.c. restoration)
4	Front gearbox oil temperature
5	Rear geabox oil temperature
6	Front gearbox bearing temperature
7	Front gearbox bearing temperature
8	Rear gearbox bearing temperature
9	Rear gearbox bearing temperature
10	Jet pipe temperature
11	Cold junction
12	Engine oil pressure
13	Front gearbox oil pressure
14	Rear gearbox oil pressure
15	Front offside suspension position
16	Front nearside suspension position
17	Rear offside suspension position
18	Rear nearside suspension position
19	Track rod position
20	Spare
21	Gearbox r.p.m.
22	Compressor r.p.m.
23	Calibration
24	Spare

Transmitter Unit

The complete transmitter unit is shown in Fig. 1 and a block diagram in Fig. 2. The transducers are connected to various circuits which are individually designed to suit the types of transducers used. The outputs from these circuits are in the form of d.c. levels and low frequency signals, the latter being fed to a multiplexing switch. This is a mechanical sampling device rotating at 12,000 r.p.m., thereby enabling signals to be sampled at the rate of 200 per second. The combined output from the first bank of the sampling switch is a.c. coupled to a transistorised amplifier which has a gain of 500; this gain decreases by 0·4 per cent for an increase in temperature of 10° C. This drift, together with any change in the sensitivity of the modulator, is compensated in the receiving equipment. Segments 1 and 2 on both banks of the sampling switch are connected to earth and by this means d.c. restoration is effected after amplification.

After amplification, the multiplexed signal is used to modulate the frequency of a sub-carrier oscillator, which employs a reactance valve and operates over a frequency range from 130 Kc/s to 160 Kc/s. The output from this oscillator is

Farm Tractor with two types of Implement Control

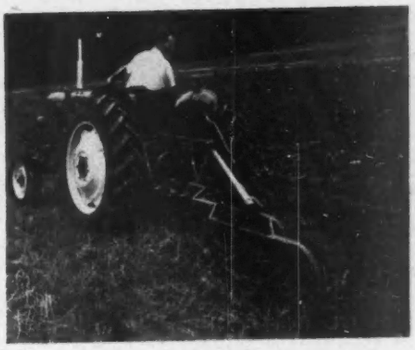
Recently introduced is the "Implematic" agricultural tractor shown designed to operate with a wide variety of farm implements, whether equipped with depth control wheel or not. This feature is claimed to overcome the dilemma in which a farmer is sometimes placed when contemplating purchase of a new tractor; in the end his choice is often governed more by suitability for use with his present implements than by the latest model of tractor available.

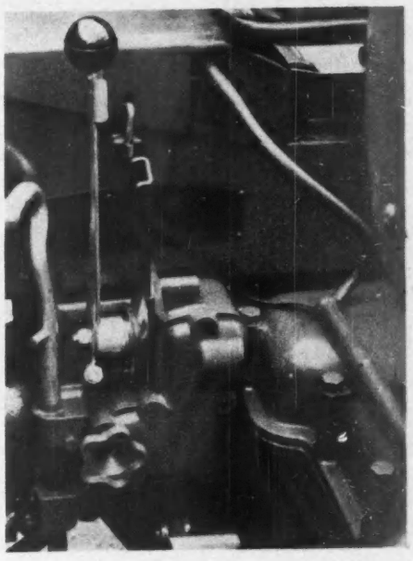
The Implematic tractor is made by the David Brown Corporation Limited, Tractor Division, Meltham, Huddersfield. Use of automatic depth control or of implements fitted with a depth control wheel is made possible by arranging the hydraulic system on a dual basis. A single control lever is used for both systems, also for applying the traction control unit (or TCU). This is a patented anti-wheel slip device, which enables a controlled proportion of surplus weight to be transferred from the implement to the tractor rear wheels when slippery ground conditions demand.

When working with implements without depth wheel, as shown in Fig. 2, the traction and depth control (or TDC) system is brought into play. The top link just behind the driver's seat is spring loaded, and is under compression when working from the ground forces acting on the implement. Movement of the top link spring under this compression is transmitted to a hydraulic valve via a response unit and a Bowden cable. Thus for any given control lever setting, the implement is forced into the ground until the preset depth is reached.

As ground conditions vary the depth automatically increases or decreases, and with it the pressure in the top link and consequently the position of the hydraulic valve. Increase in depth opens the valve allowing more oil to be pumped into the lift cylinder, thus raising the implement until the depth is restored to the preset position. Reduction in depth causes the reverse effect. When using equipment fitted with a depth wheel the hydraulic system operates in the standard fashion.

Another feature of the Implematic tractor is a differential lock which provides a second line of defence against wheel spin when the TCU alone is insufficient. This is brought into play by the driver using his right heel to depress a pedal, and can be operated with or without the UTC in use. It is useful with trailing loads.





(Above) The new 950 Implematic tractor, (right) ploughing using automatic depth control, (below) simplicity of the hydraulic controls.

Fig. 3 shows the marked simplicity of the controls for the hydraulic system. Top left is the all-purpose control lever with knob, which selects depth wheel or automatic depth control; it also initiates the TCU when required, or operates tipping loaders or trailers. Just to the right of the control lever is the preset guide for selecting the depth when on automatic depth control. Beneath the control lever is a handwheel for regulating the degree of weight transfer when using the TCU, and at the bottom of the photograph is the pedal for the differential lock.

Other particulars of the 950 Implematic tractor:

Engine: David Brown 42·5 b.h.p. 4-cylinder 4-stroke diesel, governed speed range 700 to 2,200 r.p.m.

Transmission: David Brown twin range 3-speed gear box giving six forward and two reverse speeds. Brake on gearbox input shaft to speed gear changing.

Power take-off: Belt pulley and shaft take-off are standard features.

The Implematic system is now incorporated as standard in all 950 models and also the smaller 850 size. "Livedrive" equipment can be fitted as an optional extra in each case. This is an extension of the hydraulic system which enables the tractor to move or stop, keeping the power take-off running, or both road wheels and p.t.o. to stop with the engine running, using a single three-position clutch pedal.

Concluding Telemetering for Bluebird

now used to amplitude modulate the ultra high frequency transmitter. This transmitter consists of two A 1714 triodes operating in a push-pull oscillator circuit with a tuned Lecher line. The oscillator drives a power amplifier, comprising a QQVO2-6 double beam tetrode in a push-pull configuration. The sub-carrier oscillator output is fed to the cathodes of the power amplifier via a cathode follower. A maximum of 3·5 watts mean power at 460 Mc/s may be obtained from the transmitter, the output from which is fed to a blade aerial located on one of the wheel blimps.

All power supplies for the modulator and transmitter are obtained from Bluebird's batteries. The positive h.t. supply is derived from a transistorised d.c. converter with a transistorised stabiliser incorporated. The complete transmitter unit as shown in Fig. 1 occupies less than one cubic foot and weighs approximately 15 lb. The power consumption is 3·5 amps at 24V.

Receiving and Demultiplexing Equipment

Fig. 3 shows the receiving and demultiplexing equipment as stationed in the Land Rover, and a block diagram of the receiving equipment is shown in Fig. 4. The receiving aerial is mounted on a 45 ft mast so that line of sight transmission is maintained over the 15 mile length of track. The receiver is a standard AWA u.h.f. type UR2. A low noise r.f. amplifier is incorporated using a single A 2521 valve. An overall noise temperature of 3,000° K and a bandwidth of 4·5 Mc/s is obtainable for a gain of 95 dB. The detected signal is passed from the receiver into a Travis-Round discriminator. This unit employs two circuits tuned to frequencies above and below the centre frequency of the sub-carrier. After discrimination, the signal is in the form of a stepped voltage and this is displayed on a cathode ray tube for the purposes of strobing. The synchronising channel is used to trigger the time base of the cathode ray tube.

At this stage channel 2 of the discriminator output is clamped to earth. Since channel 2 is also connected to earth at the transmitter, this eliminates zero drift. Gain drift through the system is compensated by strobing the calibration channel and adjusting a gain control on the receiving equipment to keep the calibration level constant, the calibration level being displayed on a meter after strobing. These two safeguards minimise long term zero drift and gain drift.

The strobing unit comprises five printed circuit boards, each containing four identical circuits, cathode followers and potentiometers. To enable the demultiplexing circuits to work accurately, the triggered display unit timebase should have a very constant amplitude. The normal transitron type timebase is therefore modified to incorporate a feedback loop. The timebase is then fed to the input of the strobing units, which are fully transistorised and provide a highly stable method of segregating the transmitted information.

After strobing and filtering the signals are visually displayed and recorded. The visual display consists of a cathode ray tube with a slow timebase and a long persistence phosphor face, together with a meter display. Rapidly varying quantities, such as strain gauge outputs, are displayed on the cathode ray tube and the slowly varying quantities are displayed on the meters. Attenuators are incorporated in the display unit so that correct levels may be fed to the recorder. The recorders normally used with this equipment are of the NEP ultra violet type (model 1050). This type of recorder enables the trace to be examined within seconds of recording.

This telemetry system has good long term stability and 3 per cent accuracy. The equipment has been designed for simplicity so that it can be used by a mechanical engineer.

Although tested and proved on different vehicles in this country over the past year, there was no chance of giving the equipment a thorough trial on Bluebird over here. Engineers had to work day and night so that it could be flown out to the USA in time for the first trial runs.

Current Evolution of the Grand Prix Car

With the development of lighter power units, Cooper were able to put the engine in the rear, thereby starting a trend which has spread even to larger racing cars.

By Brian Lister

DURING the last two years there has been something of a revolution in the design of the Grand Prix car. The classic conception of the ideal car in 1958 was exemplified by the Maserati, Ferrari, Vanwall and BRM designs. Engines were at the front, the gearbox in most cases at the rear, in unit with the final drive crown wheel and pinion; there was normally a de Dion suspension at the rear and wire wheels were fitted and secured by knock-on Rudge Whitworth style hubs. The whole car weighed dry around 15 cwt. In fact, looking back, the Grand Prix car has remained very similar, except for changes in formula, since the late 30's.

Today a more usual arrangement is that found in the Cooper, the new BRM, the rear-engined Ferrari, and the Lotus cars. Here both the engine and the gearbox are in unit at the rear; a form of independent rear suspension is fitted; and in most cases there are bolt-on light-alloy wheels. The whole car weighs some 10 cwt.

WHEELS CHANGE—AND SUSPENSION

It is easy to see why the old quick-change wheels have fallen into disfavour. There are six principal reasons.

(1) Tyres today last much longer.
(2) Races are shorter than hitherto.
(3) Road surfaces are much better than they were on circuits immediately before and after the war.
(4) Cars weigh less and therefore less demand is made upon the tyres.
(5) With lighter cars unsprung weight must be kept down to a minimum.
(6) The 2½ litre formula engines are generally producing less power than with previous formulae.

The de Dion suspension was invented originally for Count de Dion to use in his steam cars before the turn of the century. It was later revived by Mercedes in 1936 when they started experimenting with it on their Grand Prix cars. They adopted this form of suspension completely in 1937 and since then it has been used almost exclusively on Grand Prix cars.

A de Dion suspension is a somewhat cumbersome piece of equipment, although it certainly works very well, and it is one of the easiest suspensions to design. The drive unit is secured solidly to the frame and drives the rear wheels through a pair of universal joints on each side. The wheels are held in position by an axle which is swept round or over the drive unit. The axle is attached to the frame laterally by a block in a slide, or a Watt's linkage, or a long Panhard rod, and fore and aft by radius rods, although numerous variations are possible. Most of them have, of course, been tried.

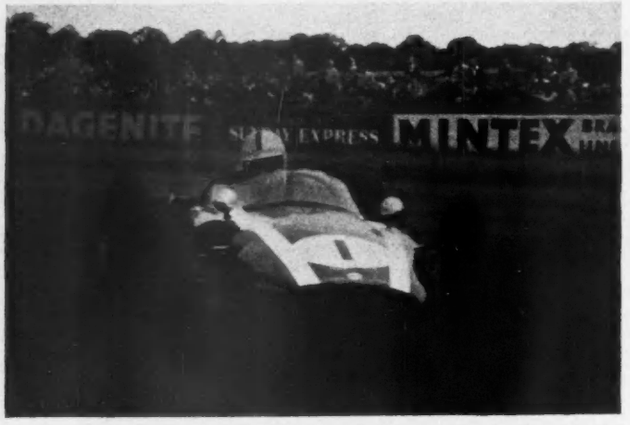
Thus, with a de Dion suspension there are all the advantages of a live axle without its main disadvantage, namely, the high unsprung weight. The main objection to the de Dion arrangement is its excessive overall weight and complication. The alternative is obviously independent rear suspension. But many racing and passenger cars which have been fitted in the past with independent rear suspension have had a disturbing tendency to oversteer at the rear under high cornering loads.

Several different systems of independent rear suspension are now in use, and judging by the excellent road holding of the modern Grand Prix cars it seems that the main objection to independent suspension at the rear has now been overcome. It has come into use, one notices, on today's light Grand Prix cars, as it has on some light passenger cars. Whether the aforementioned difficulties with road holding have been overcome on heavier motor cars only time alone will tell.

Most designers knew that it was only a matter of time before independent rear suspension was fitted to racing cars in general. What was not so clearly inevitable was the move to rear engines.

REAR-ENGINE BREAK AWAY

Probably the experience with the pre-war Auto Union cars, where a rear engine was used in conjunction with swing axles, put the general use of rear-engined racing cars back for nearly two decades. The Auto Union was designed basically by Dr. Porsche, who also did much of the design work on the Volkswagen. Porsche was a great advocate of both rear engines and swing axles. Anyone who has driven a Volkswagen must know how these cars break away when pressed to the limit; imagine then how much more difficult it was to drive a 1937 Auto Union with the same arrangement and very little more weight but some 520 b.h.p. available instead of the 36 or so horse-power on the Volkswagen. It is a fact that only the late Berndt Rosemeyer really mastered the technique of handling these cars and this was remembered by designers who probably would otherwise have experimented before now with rear-engined racing cars.



A 1960 Grand Prix Cooper driven by world champion Jack Brabham at Silverstone. Note rear-wheel lean. When Cooper installed a Coventry Climax 2½ litre engine in the rear of a car intended for Formula I racing they set the pattern for the Grand Prix car designers everywhere.

Cooper of Surbiton, who really started the rear-engine crusade, fitted rear engines in their original 500 c.c. racing cars, the first of which was built in 1946. The main reasons that Cooper chose to instal the 500 c.c. engine in the back was because, being of motor-cycle origin, it had chain drive. Therefore to have a 500 c.c. engine at the front meant having front-wheel drive and all the attendant problems and disadvantages. There was nothing more logical than putting the engine at the rear, more specially as it did not weigh anywhere near as much as a normal water-cooled unit. And of course, a live axle would be difficult to drive by chain, so Coopers developed a simple independent rear suspension which was built up from similar parts to those used in the independent front suspension of Fiat origin which they were using at the front. The car worked very well, and orders soon started coming in for 500's.

COOPER BRISTOLS

In 1948 Coopers took another step and installed both 1,000 c.c. and 1,100 c.c. engines in place of the 500 c.c. units. Many people shook their heads and prophesied difficulties similar to those experienced with the Auto Union, but these cars were a fabulous success. The year 1952 saw Coopers go over to front-engine cars. These were the original Cooper Bristols, the most famous of which was driven by the late Mike Hawthorn. Even Coopers stopped at that time at putting such a heavy unit as the Bristol into the rear of such a light car. But, within a year or so they had started to use the light 1,100 c.c. Coventry Climax fire-pump engine, and once again, in unit with the Citroen gearbox, they installed it in the rear of the Cooper chassis.

It was a tremendous success, and then in 1955 one or two drivers, foremost among them the present world champion, Jack Brabham, put a Bristol engine in the back of a Cooper designed to take the Coventry Climax unit. This car was also successful.

COVENTRY CLIMAX

The next engine to be made available to them was the 1500 c.c. twin overhead camshaft Coventry Climax racing unit. This engine was, of course, designed for Formula II racing (1960 is incidentally the last year of the 1½ litre Formula II limit). From the very beginning these cars were the most successful Coopers of all, and it was a logical development for the company to bore the engines out to 2 litres. In this guise they started rivalling the speeds of the Formula I cars which were permitted up to 2½ litres engine capacity, and it was not long before Charles and John Cooper managed to persuade Coventry Climax Limited to build them a special 2½ litre unit intended especially for Formula I racing.

The writing was on the wall for the rest of the Grand Prix car manufacturers. That was in 1959, the first year these cars were run in Formula I. Rear engines had quite obviously come to stay, and in that same year a 2½ litre rear-engined Cooper won the world manufacturer's championship for the first time.

It is significant that since last year all other factories building Grand Prix cars have gone over from front-engined vehicles to rear-engined vehicles. Who knows, had it not been for the original 500 c.c. car we should still be seeing Grand Prix cars racing with engines at the front in 1960.

Britain probably has now as many motor-racing circuits as any other country, among the foremost being Silverstone, Snetterton, Goodwood, Aintree, Crystal Palace, Brands Hatch, Oulton Park, Charterall and Mallory Park. At the same time more races are held here than in any other country. It is one reason for our present leadership both in racing-car design and in wealth of drivers.

Britain's Missile Tested at Spadeadam

Although the Blue Streak project is still in the balance, test work is being continued at Spadeadam, Cumberland.

LAST week, some of the secrets of Britain's most powerful weapon were revealed to the press a mile or two north of Moscow, while our security police stood by undismayed. No Russian was present, however, for this Moscow was not the Soviet capital but a small farm in Cumberland, near Hadrian's Wall. It is the last habitation on the road to the Spadeadam Rocket Establishment, built for the purpose of developing and testing the British ballistic missile Blue Streak.

British strategists having decided that any gound-based ballistic missile would be too vulnerable to enemy attack, all constructional work at Spadeadam has been stopped; although engine and vehicle testing is still continuing on a reduced scale until the government makes its long-awaited decision whether to proceed to develop Blue Streak for use as a space carrier vehicle.

This site was chosen as probably the only one of its size still available in England (there would be alternatives in the Scottish highlands). Although reasonably close to the Rolls-Royce works which produce the engines, the site had many disadvantages. Maps describe it as Spadeadam Forest or Spadeadam Waste; the forest disappeared some centuries ago and was replaced by a bog. This is still present, although parts of the area were planted with spruce by the Forestry Commission before the Ministry of Aviation took over the site.

Construction of the establishment was undertaken by the Ministry of Works, after the Ministry of Aviation had specified the number of test stands, their spacing apart, and so on. The main contractors were British Oxygen Engineering Limited and George Wimpey and Company Limited; later they formed a joint company for this purpose. The massive test stands had to be located where suitable load-bearing ground was available. The dispersion of the various facilities necessitated the construction of six miles of road; after experiencing difficulties because of the bogs the Roman method of floating roads on piles of brushwood gave satisfactory results.

The establishment was first conceived in 1955, and construction took place mainly between January, 1957, and January, 1960, at the peak period about 2,000 were engaged on the work—all imported from outside the area and housed in a camp nearby. This and the nature of the site increased the construction costs, and doubts concerning the value of the missile caused the government to be sparing in advancing money for the project.

There are five separate areas in the establishment: administration and assembly, liquid Oxygen (LOX) plant, component test, engine test, and missile test.

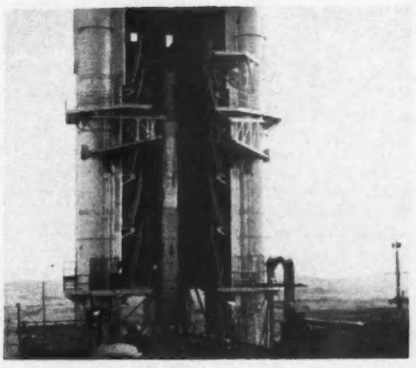
BLUE STREAK POWER

Blue Streak is powered by two similar LOX/kerosine engines, developed by Rolls-Royce from the S 3 engine of the Rocketdyne Division of North American Aviation Incorporated. The engines (known as RZ1 and RZ2) were first run at the Rocket Propulsion Department, Westcott (then part of RAE) in 1957, and first tested at Spadeadam about 18 months ago. The early engines each developed 135,000 lb thrust but this value has now been exceeded. The engine is 10 ft 7 in high and weighs about 1,500 lb when dry.

Each engine consists essentially of a turbopump and a thrust chamber. The turbopump unit supplies propellents to the chamber and includes a gas generator (a small combustion chamber in which small amounts of propellent react to give hot gas), a gas turbine, gearcase, kerosine and LOX pumps, pneumatic and instrumentation units and auxiliaries. The thrust chamber is shaped to form a convergent-divergent nozzle with a long conical exhaust nozzle. This is made up of a series of square-sectioned nickel tubes welded together longitudinally. The lower ends of the tubes all open into a single annular tube; the upper ends open alternately into inlet and exit manifolds. Kerosine from the turbopump passes down one set of tubes and back up the adjacent tubes and is then injected into the thrust chamber; in this way the chamber is regeneratively cooled. The propellents are injected through small holes in an injector plate.

The missile bodies are manufactured from thin stainless steel sheet by de Havilland Propellers Limited at Stevenage and Hatfield. They consist of a cylindrical LOX tank between a cylindrical kerosine tank and a frustroconical guidance compartment (the nose cone and warhead would be fitted on this later). The LOX tank is smooth externally, but the other two sections are reinforced with external longitudinal ribs of top-hat section. There is a skirt below the kerosine tank to house the two engines.

The LOX plant is operated and maintained by



Missile test tower, A1, at the Spadeadam Rocket Test Establishment.

British Oxygen Gases Limited. It contains standard commercial equipment, comprising two units each capable of a daily production of 50 tons LOX, 80 tons liquid nitrogen and 60 tons gaseous nitrogen. Only one unit is operating at present, but whether one or both is running, this is done on a 24-hour day, 7-day week basis, it being more economic to do this than to keep stopping and starting-up the plant. Surplus LOX is sold commercially, any nitrogen surplus to the establishment's requirements is returned to the air (as are the rare gases). The LOX is stored in a 500 ton capacity insulated tank and distributed by road tankers. Kerosine (ordinary Aladdin Pink) is taken to the test areas by road tankers direct from the refineries.

Sub-assemblies of component parts of the engines are calibrated and tested in nine individual concrete test cells in the component test area. The cell for testing the gas generator has now been closed down. The rig for testing the gas turbine has not been completed and probably never will be; the turbine used is a 7,500 lb thrust engine developed by Rolls-Royce for aircraft use and superior to the original Rocketdyne equipment.

The only active facilities in this area at present are two turbopump testing cells—one using kerosine and water (run to waste), the other kerosine and LOX (which are recirculated). A separate building contains a high flow water test facility now 95 per cent complete. Designed for use also with later engines larger than those of Blue Streak, it has pumps which can be coupled either in parallel or in series, giving either 6,000 gallons per min at 300 lb per sq. in or 2,000 gallons per min at 930 lb per sq. in. It is intended for calibrating flowmeters, injectors, combustion chamber jackets, etc., but could be used for any equipment needing a large water flow; there is thought to be nothing as large in Britain.

This area has a central control room blockhouse, instrumented mainly by Pye Limited.

FOUR TEST SITES

The engine test area (Site A) is about a mile away, and consists of a group of four engine test stands, clearly visible from the Carlisle-Newcastle road. Three of these stands were erected according to American practice, 250 ft apart, and each consisting of a massive concrete and steel structure in which the rocket engine can be mounted to fire verticaly downwards into a water-cooled steel flame deflector. An 8,000 gallon LOX tank and a 5,500 gallon Kerosine tank are mounted one above the other above the engine and are pressurised with nitrogen.

The safety precautions for stands A1-A3 were found to be excessive and stand A4 is of British design. It has a prestressed concrete frame and is placed quite close to A3. The two propellent tanks are at ground level on either side of the engine, so that the stand is squat and much less conspicuous than the others. All four stands are on the side of a hill; when an engine is fired large quantities of water are pumped through holes in the face of the deflector, which is used to make the rocket flame shoot out horizontally. The excess water runs down large concrete channels to a treatment plant where it is freed from solids and kerosine before being returned to the area reservoir.

An underground concrete cable duct, 7 ft square and 1,100 ft long, connects the test stands with the control blockhouse, 600 ft from A1. The building is built of 2 ft thick reinforced concrete and equipped with 130 chart recorders, four 24-channel oscillographs, closed-circuit television and submarine-type periscopes. Eight control consoles are being installed.

As the missile test area is incomplete, the A1 stand has been converted for temporary use as a missile test stand. It has a large fixed tower and is fitted with a missile firing pad, although not an exact replica of that to be used at Woomera. Missiles from the assembly bay are brought up still attached to their carrier frame, a pivot attachment is bolted on to one end of this, and it is winched up by hand into a vertical position just in front of the stand. A carrier ring hanging from a cable is bolted on to the top of the missile, the frame released and the missile hoisted up, brought into the stand, lowered on to the firing pad, and clamped down.

About 1¾ miles away is Site C, the Missile Test Area. This has two widely separated missile test stands, C2 and C3, each having a transversing servicing tower which can be withdrawn along a 300 ft concrete causeway. The tower incorporates a gantry for elevating the missile. The towers have portal frames open at two sides and fitted with servicing platforms which are raised before moving the tower away from the missile.

Stand C2 is incomplete, but C3 is virtually complete, equipment for refrigeration, power supply, instrumentation, air conditioning, etc., being ready for installation beneath the causeway. C3 would be ready within a few months of the word being given to go ahead.

There is a control blockhouse 1,000 ft away from the stands; its instrumentation was designed and installed by de Havilland's, except for a Rolls-Royce engine panel. The main system comprises 19 control consoles, 4 checkout consoles, 27 chart controllers with a total of

Continued on next page

Mixing Gases and Gibbs' Paradox

Gibbs' paradox presents a discontinuity in the usual theory of gas mixtures which cannot easily be justified. A new solution is presented by a well known French engineer.

By P. Chambadal, Electricité de France

THE CONVENTIONAL theory of mixing of gases or vapours is based on a second law analysis. Consider two chemically different gases which are contained in a vessel (Fig. 1) where they have the same pressure and temperature p and T, their partial volumes being V_1 and V_2, and their total volume being $V = V_1 + V_2$. The gases are separated by an impermeable wall or membrane (w). If this wall is removed, the gases mix and each of them occupies the whole volume V; assuming that the walls of the vessel prevent any exchange of heat with the surrounding atmosphere, the temperature inside the vessel will remain unchanged, and so will the pressure. In these conditions the mixing is an adiabatic process; but as the separation of the mixture into its constituents never occurs spontaneously, we are told that the process of mixing is an irreversible one, and therefore it implies an increase of entropy and, accordingly, a decrease of available energy.

ENTROPY CHANGE

The evaluation of the entropy change is usually founded on the assumption that the diffusion of the gases is performed through imaginary semi-permeable membranes which offer no resistance to crossing by one of the gases but are entirely impermeable to the other. We can imagine that membranes of this kind are used either for mixing of two gases or, inversely, for the separation of a mixture into its constituents; it is obvious that in both cases the calculation of the entropy change leads to results which differ only in sign. But the same value of the entropy change can also be obtained without having recourse to the imaginary membranes, by means of a direct comparison of the initial and final entropies of the constituents, as is shown in the following calculation:

Let us denote by m_1 the mass of gas 1, by R_1 its gas constant, by c_1 its specific heat at constant pressure, and by p_1 its partial pressure in the mixture ($p_1 = \frac{p\,V_1}{V}$, where V_1 is the volume the gas would occupy if it were under the pressure p). The removal of the dividing wall (w) in Fig. 1 leads to a mutual diffusion of the gases; in case of gas 1, this diffusion is equivalent to a throttling from pressure p to pressure p_1, and it is well known that the corresponding increase of entropy is

$$(\Delta S)_1 = \frac{m_1 R_1}{J} \ln \frac{p}{p_1}$$

where J is the mechanical equivalent of heat, 778 ft-lb per Btu.

In a similar way we have for gas 2

$$(\Delta S)_2 = \frac{m_2 R_2}{J} \ln \frac{p}{p_2},$$

and the total increase of entropy can be written:

$$\Delta S = (\Delta S)_1 + (\Delta S)_2 = \frac{1}{J}\left(m_1 R_1 \ln \frac{p}{p_1} + m_2 R_2 \ln \frac{p}{p_2}\right) \quad (1)$$

Instead of the masses m_1 and m_2, we can introduce into the expression of ΔS the numbers n_1 and n_2 of lb mol of the constituents, according to the relations

$$m_1 R_1 = n_1 R \text{ and } m_2 R_2 = n_2 R$$

where R is the universal gas constant 1,545 ft lb per lb mol ° F. Thus we obtain

$$\Delta S = \frac{R}{J}\left(n_1 \ln \frac{p}{p_1} + n_2 \ln \frac{p}{p_2}\right) \quad (2)$$

It is easy to find the available energy decrease corresponding to the entropy increase ΔS. In this discussion we mean by *available energy* the maximum work which can be supplied by a given gas when the surrounding atmosphere has a constant pressure p_0 and a constant absolute temperature T_0. Then the decrease of available energy is given for gas 1 by the well known relation

$$(\Delta W)_1 = T_0 (\Delta S)_1$$

and for gas 2 by

$$(\Delta W)_2 = T_0 (\Delta S)_2.$$

The total decrease of available energy is consequently

$$\Delta W = (\Delta W)_1 + (\Delta W)_2 = T_0 (\Delta S)_1 + T_0 (\Delta S)_2 = T_0 \Delta S \quad (3)$$

But if we consider the expressions (2) and (3), we see that they are independent of the nature of the mixed gases; it follows that the changes of entropy and of available energy should be the same even if the mixed gases were identical, and this surprising conclusion is known as Gibbs' paradox.

INTERPRETATION

Usually this paradox is interpreted in one or other of the following two ways. Some authors believe that the entropy change has the same finite value however small may be the difference in nature between the gases, but becomes zero when the gases are identical; they point out that in the latter case no experiment can detect any difference between the constituents of the mixture, and this peculiarity introduces a discontinuity into the value of entropy change. But if this explanation is true, it remains to show why it does not appear in the expressions of ΔS and ΔW where the chemical nature of the constituents does not intervene at all. Other physicists, on the contrary, consider each pure gas as a mixture of N constituents where N is the number of molecules, and this conception involves an enormous amount of entropy which is conventionally eliminated from the formula. Thus both of the usual interpretations introduce into the expression of ΔS an artificial discontinuity which has in the two cases not only a different numerical value, but also a different physical meaning. It seems difficult to find such a situation satisfactory; but it is obvious that if the Gibbs' paradox is a logical corrollary of the reasoning (and that is undoubtedly the case), there must be something wrong in the reasoning itself. Let us try to find out what it is.

To begin with, is it quite sure that the mixing of gases *having the same pressure and temperature* is an irreversible process? The usual answer is: "Yes, this process is irreversible, as the reverse process or decomposition never occurs spontaneously." But this reason is not sufficient: nor does the compression of a gas occur ever spontaneously, and that does not prevent us from conceiving and studying reversible expansions. Moreover, we are not interested here in the decomposition of the mixture, but in its available energy, i.e. in the maximum work which can be obtained from it for given values of p_0 and T_0. Thus we arrive at a first conclusion which is at the same time very simple and very important: the thermodynamic properties of a mixture of gases may vary accordingly in each case if the mixture is considered as a source of mechanical work, or as a source of several pure gases. We shall see that they are actually different and moreover that in both cases the Gibbs' paradox can be cleared up.

Our first task will be to see whether the process of mixing entails really the entropy increase given by (2) and, consequently, the available energy decrease given by (3). The removal of dividing wall (Fig. 1) which produces the mixing is accompanied neither by any exchange of the heat nor by any generation of work and it leaves unchanged the pressure p and the temperature T inside the vessel; so there is no physical measurement which might justify a decrease of the available energy of the gas. It is only when we become aware that the gases contained in the two parts of the vessel are not of the same nature that we begin to consider, instead of the total pressure p, the partial pressures p_1 and p_2, and we find then a similarity between the mixing and the throttling. But as a matter of fact, the partial pressures have to intervene only into throttling, not into mixing; it is easy to show that in the latter case the consideration of the pressures p_1 and p_2 in place of the total pressure p has no influence on the value of the available energy.

If we consider 1 lb of a perfect gas under the pressure p and the absolute temperature T, we can represent its state in the entropy chart

Continued on next page

Concluding **Britain's Missile Tested at Spadeadam**

216 channels, and four types of magnetic tape recorder (49 channels). There are Bark and Stroud observation periscopes, episcopes and closed-circuit television.

Two test firings of twin-engine units were made on the day of the press visit. In the first, the unit ran for only three seconds; as the fuel supply to an igniter was not registering the required pressure, an automatic device then cut out the engine. In the second test, the unit functioned satisfactorily.

Engineers, scientists and technicians at Spadeadam take great pride in their achievements. Blue Streak was originally based upon American know-how but is essentially a British design. All at Spadeadam have worked hard to improve the missile's performance and to have it ready as soon as possible. Its abandonment as a weapon was a heavy blow; now that it is ready for its flight trials, it will be doubly hard for them if they learn that it has been decided to scrap everything. The missiles themselves will be practically worthless as scrap and much of the expenditure on the establishment could not be recovered.

The least that the government can do to keep faith with those who have spent several years on this project is to go through with the flight trials. Better still, it could approve the use of Blue Streak for upper atmosphere research—carrying scientific instruments vertically upwards or in a ballistic trajectory. In either case more money would be spent (thousands of pounds) but there would be some return on past expenditure. More expensive, but best of all, would be to follow this with the adaption of Blue Streak and Black Knight as a satellite launcher. Until a decision on these points is made, the future of Spadeadam and its 600 employees hangs in the balance.

(Fig. 2) by the point A having the coordinates T and S. In order to obtain the available energy of the gas, we can expand it adiabatically to the ambient temperature T_0 (A C) and then compress it isothermally to the ambient pressure p_0 (C B) (of course, we assume that both operations are reversible). The work supplied by the adiabatic and isentropic expansion A C is given by $H - H_0$ where H and H_0 are the enthalpies of the gas at the points A and C. On the other hand, the work spent for the isothermal compression C B is given by $T_0 (S - S_0)$, S and S_0 being the entropies at the points C and B. Thus the available energy is

$$W = H - H_0 - T_0 (S - S_0),$$

and this expression is good also in the case when the pressure p'_0 at the end of expansion is greater than p_0 instead of being smaller as in the case of Fig. 2.

Now, if the gas is throttled to the pressure p_1, this operation is represented in Fig. 2 by A A_1. In this case the available energy will be obtained assuming that the gas undergoes an adiabatic expansion A_1 C_1 followed by an isothermal compression C_1 B. It is obvious that the available energy of the throttled gas is

$$W_1 = H_1 - H_0 - T_0 (S_1 - S_0),$$

H_1 and S_1 being its enthalpy and entropy at point A_1 (end of the throttling). As $H_1 = H$ and $S_1 > S$, $W_1 < W$, so that the throttling entails a decrease of available energy:

$$\Delta W = W - W_1 = T_0 (S_1 - S) = T_0 (\Delta S)_1.$$

But if the substitution of pressure p_0 for pressure p does not result from a throttling, but from a mixing of several gases, the preceding reasoning cannot be applied. In this case p_0 is no more the pressure of the considered gas, but its partial pressure in a mixture; now the word *partial* shows that this pressure has a physical meaning only as far as the gas is a part of a mixture, and then the ratio of the partial to the total pressure remains unchanged whatever may be the thermodynamic processes performed by the mixture. It follows that in this case the isothermal compression starting at point C_1 ends when the *mixture* (and not one of its constituents) reaches the surrounding pressure p_0; the partial pressure p_{01} of the constituent is then given by the relation

$$\frac{p_{01}}{p_0} = \frac{p_1}{p},$$

and consequently its entropy S_{01} (at B_1) satisfies the relation

$$S_1 - S_{01} = S - S_0.$$

Thus the available energy of the constituent gas 1 is the same as before mixing, and so is, of course, the available energy of all other constituents of the mixture. The conclusion is that the available energy of a mixture of gases is equal to the total available energy of its constituents before the mixing, assuming that all of them had initially the same temperature and the same pressure. Thus it is unnecessary to introduce any discontinuity between a mixture and a pure gas, and that seems to be the solution of Gibbs' paradox.[1]

ARTIFICIAL CONCEPT

This conclusion can be easily illustrated by an example. If you mix 0·768 lb of nitrogen with 0·232 lb of oxygen under the same temperature and pressure, you will obtain 1 lb of air and you will have at your disposal the same amount of available energy as before the mixing. In other words, 1 lb of nitrogen (or of oxygen) contained in a vessel under the ambient pressure p_0 and temperature T_0 has the same available energy as 1 lb of the same gas in the surrounding atmosphere, in spite of the fact that in the latter case its partial pressure is lower than p_0. It would not be so if we were in possession of a semi-permeable membrane allowing the expansion of the nitrogen from its initial pressure p_0 to its partial pressure p_1 in the atmosphere: this expansion would increase the work produced by the nitrogen, so that equation (3) would be justified.[2] The flaw in the usual theory of

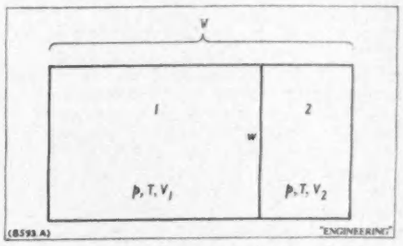


Fig. 1 State of two gases before mixing.

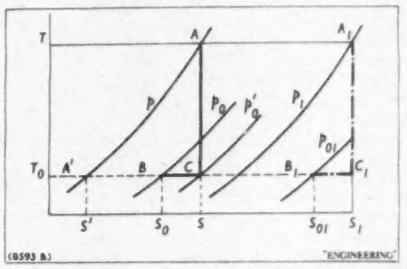


Fig. 2 Calculation of available energy for a pure gas and for a mixture.

mixing is that it assumes the existence of such membranes for all gases, whereas they are known only for some very exceptional cases (hydrogen and some gases soluble in water). It is obvious that if all mixtures could be decomposed by means of membranes, whatever might be the chemical differences between their constituents, there would be a radical dissimilarity between a mixture and a pure gas; but as it is not the case, the Gibbs's paradox is no more than a product of a very artificial conception of gas mixtures.

MAXWELL'S DEMON

Let us now leave out of account the available energy of the mixture and consider only the problem of its decomposition into its constituents. At first sight, the work necessary for this decomposition should be a function of the entropy increase accompanying the mixing and given by (2); whereas this relation is of no use for the calculation of available energy of a mixture, it would be useful for computation of the cost of separation of its constituents. But that is not so, as it is shown by the following example, in which Professor J. Ackeret points out that the decomposition of a mixture consisting of 99·3 per cent $U^{(238)}F_6$ and 0·7 per cent $U^{(235)}$ requires theoretically (i.e. taking as basis the entropy change) 0·023 kWh per kilogramme of the latter constituent, and that the actual work reaches $1{\cdot}2 \times 10^6$ kWh, a figure which is about fifty million times greater; that is the reason why one of the American plants where the uranium isotopes are separated by gaseous diffusion consumes more electric energy than the whole of Switzerland.[3] Now, however imperfect may be the human achievements, particularly in the field of applied thermodynamics, their efficiency is never so low as 0·000,002 per cent, and that shows that in the present case the definition of the "theoretical" work is a wrong one. As a matter of fact, this definition does not take into account the *degree* of difference in nature of the constituents, and in the present case the necessary work is enormous precisely because this difference is a very small one. If the same process of decomposition were applied, for instance, to a mixture of carbon dioxide and of helium, the necessary work would be much smaller than in the case of the two isotopes of uranium; on the contrary, in the case of a mixture of two identical gases, it would be impossible to bring together again all the molecules of each constituent, so that the involved work would then be infinite.

Some modern physicists (L. Szilard, C. E. Shannon, N. Wiener, L. Brillouin, and others) propose a very ingenious explanation for this difficulty (or, rather, for a similar one). Imagine that the vessel in Fig. 1 contains in its two portions 1 and 2 the same homogeneous mixtures of two gases A and B, and that a Maxwell's demon (i.e., a being who can see and follow the individual molecules) opens and closes a small hole in the dividing wall *w*, so as to allow only the molecules of gas A to pass from 2 to 1, and only the molecules of gas B to pass from 1 to 2. He will thus decompose the mixture into its constituents without expenditure of work and, consequently, without any change of entropy. He also would be able (as in Maxwell's reasoning) to select the molecules by their speed and thus generate, without work, a difference in temperature between 1 and 2, which would be obviously in contradiction with the second law of thermodynamics. But these conclusions are no longer accepted. As the inside of the vessel is in equilibrium at constant temperature, the radiation there must be that of the black body, so that the demon cannot see the molecules and is unable to operate the trap door and to transgress the second law. We may enable him to see the molecules if we equip him with a source of radiation such as an electric torch, but this torch introduces into the system negative entropy (or "negentropy"), and the entropy balance shows that the second law is always satisfied.[4] Of course, Clausius was right in saying (in his *Mechanical Theory of Heat*) that the second law does not deal with what the nature is able to do with the help of demons, but with what it is able to do by itself; yet it is not immaterial to know that even the assistance of demons cannot enable the nature to violate the second law of thermodynamics.

We can now understand why the work necessary for the decomposition of the mixture cannot be calculated by means of the entropy change given by (2). The selection of molecules needs "information" about their nature, and this information is obtained from the negative entropy poured into the system. But it is obvious that the necessary information becomes greater as the two kinds of molecules become more similar, and so does the amount of energy which has to be supplied to the system. That is the reason why the separation of two isotopes requires such a great expenditure of energy. As the relation (2) does not take into consideration the degree of difference between the gases, it cannot be used for the calculation of the work necessary for their separation. We may add that in the present case Gibbs' paradox must be reversed: instead of saying that there is an entropy increase *even* for a mixture of very similar gases, we must say that the entropy increases *especially* in such a circumstance. Gibbs' paradox relates to the independence of the entropy change from the degree of difference in nature of the constituents; actually the entropy change varies in the opposite direction to this difference and tends to an infinite value when the difference tends to zero. But this fact seems paradoxical only if we remain on the ground of classical thermodynamics; the anomaly vanishes if we take into account the new theory which shows that the entropy increase is a measure of the difficulty we have in trying to discern different kinds of molecules in a mixture of gases.

Thus we come to the general conclusion that the conventional theory of mixing of gases cannot find any practical application neither for the calculation of the available energy of the mixture nor for that of the energy required for the separation of its constituents.

References

[1] P. Chambadal, "Sur les Propriétés Thermodynamiques des Mélanges de Gaz," *Chaleur et Industrie*, December, 1958. Discussion in issues of April, September and November, 1959.

[2] R. Marchal, Discussion of paper by Chambadal (Ref. 1), *Chaleur et Industrie*, April, 1959.

[3] J. Ackeret, "Die Entwicklung des Entropiebegriffes," *Schweizerische Bauzeitung*, 14 May, 1959.

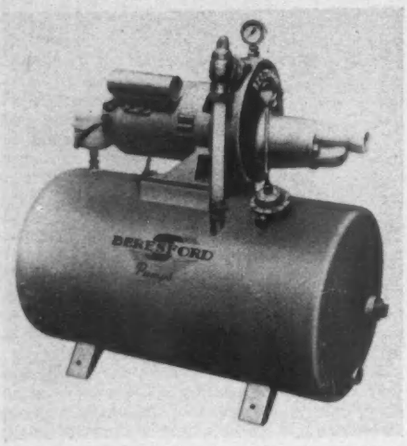
[4] J. Brillouin, "Maxwell's Demon Cannot Operate," *Journal of Applied Physics*, March, 1951.

At Home

Well-Water on Tap

AN INCONVENIENCE of living deep in the country is the absence of main services. Although in many areas electricity is being brought to the most remote of homes and farms, the possibility of having water mains is priced out. Therefore, for very many years, if not permanently, there will be a great number of houses which have to rely on wells for their water supply. There will also be that section of people who still prefer well water for drinking even after a (chlorinated) mains supply has reached them.

Energy is required to pump water from a well and the daily toil on the kitchen pump can be a nightmare for older folk. Where there is electricity the problem is eased as motorised pumps can be installed with automatic float switches to start and stop them as the level in the storage tank varies. Diesel or petrol driven pumps can also be used, of course, but for noise reasons they are usually confined to outhouses whereas the electric pump can be installed directly in the kitchen or scullery.



Both the Beresford (above) and the Firth Cleveland (right) automatic pumping units operate without a roof storage tank, supplying water as soon as a tap is turned on.

Two automatic pumping systems have recently come on the market which do not need a roof storage tank and consequently eliminate the risk of flooding due to burst pipes. The risk of the water becoming tainted as a result of standing is also removed. With them, water at full pressure is immediately available at any tap in the house.

The system by James Beresford and Son, of Kitts Green, Birmingham, 33, is shown in the first illustration. Two models are made both of which can be adapted for deep or shallow wells, the price being from £46 upwards.

An electrically driven single stage centrifugal pump is mounted on a small storage tank that is also used to provide the working pressure. Controls mounted on the tank include one for the volume of air in the tank and a pressure switch for controlling the running of the motor. The unit can be installed in any position convenient for running the pipes. The type A shallow well model will lift the water a maximum of 20 ft and the deep well version 45 ft. Discharge pressures range from 15 to 35 lb per sq. in. The tank capacity is 18 gallons.

The air in the tank forms a cushion that is automatically maintained by the air volume control working in conjunction with the pump. When water is drawn off, the pressure and the level in the tank fall until a point is reached at which the pressure switch operates and starts the motor. When the tank is replenished the motor is automatically cut out. The switching points are set so that a reasonable amount of water can be drawn off before the motor starts, so that under normal domestic requirements the motor is only running at infrequent intervals. A roof tank is only required if there is a boiler or central heating system in the house.

A jet unit is used to improve the suction characteristics, being in the case of the shallow well model coupled direct to the pump and in deep well installations mounted below water level in the well and connected by two pipes, one for the suction and the other to provide the water drive for the jet. The pump has a gun-metal impeller and the spring loaded carbon seals are water lubricated. The smaller model, type A, has a ¼ h.p. motor and the larger type B one of ½ h.p. As a deep well unit type B has a maximum lift of 80 ft with discharge pressures between 20 and 24 lb per sq. in and deliveries up to 610 gallons per hour. The tank holds 32 gallons.

The unit shown in the second illustration is one of the models made by Firth Cleveland Pumps Limited, of Earl Shilton, Leicestershire. The principle is in general the same as that of the Beresford unit and no storage tank is required in the roof. The pressure regulator on the pump is set to the pressure required by the user and the pump then fills the tank till this value is reached. The compressed air in the tank forces the water along the pipes when a tap is turned on. The larger the tank, the longer will be the period between pump operations as more water can be drawn off before the pressure will fall below the set figure.

To cover the varying requirements, six sizes of pump are made for well depths of 180 ft and capacities up to 2,250 gallons per hour at delivery pressures of 70 lb per sq. in. For deeper wells submersible pumps can be used. Pressure tanks vary from 2 to 30 gallons capacity as desired. The smaller units can be accommodated below the draining board in the kitchen and even the largest pump measures only 19½ in by 12½ in by 8½ in. Bronze impellers are used and it is claimed that the pumps are quiet in operation and self priming at all depths. An automatically operated petrol engine is being developed for driving the pumps where there is no electricity available.

A separate water supply renders the owner free from seasonal restrictions and from water rate charges. Construction costs can be reduced by the absence of the roof tank and by the fact that small bore pipes can be used. The bore for the well need only measure 6 in outside diameter which can be driven for about £1 per ft, though costs vary widely from place to place.

ENGINEERING

Published every Friday by Engineering Ltd. at 36 Bedford Street, London, WC2, England.
Telephone: Temple Bar 3663.
Telegrams: Engineering Lesquare London.

Chairman
J. A. Dixon, M.A., A.M.I.Mech.E.

Editor
F. B. Roberts, M.B.E., M.I.Mech.E.

Deputy Editors
D. Fisher, Ph.D., B.Sc., A.M.I.C.E., A.M.I.Mech.E., E. P. Ward, M.A., A.M.I.Mech.E.

Department Editors
Atomic Review
D. d'A. R. Blackwall, B.Sc.
Book Reviews
E. P. Ward (Deputy Editor)
Construction
D. Fisher (Deputy Editor)
Design
K. M. Brown
Events in Advance
J. E. Dodsworth
Impact, Human Element, Companies, Marketing
J. D. F. Perry
Metals and Materials
D. C. E. Gribble, B.Sc.
New Plant and Equipment; At Home
A. A. H. Scott, B.Sc., A.M.I.Mech.E.
Production
J. R. Trotter, B.A.
Research and Development
R. A. Coffee, D.I.C., A.M.Brit.I.R.E.

EDITORIAL DESIGNER
J. T. Godfrey

SUBSCRIPTION MANAGER
G. A. Roberts

ADVERTISEMENT MANAGER
G. H. Dixon, M.A.

Contributed Articles
Notes for the guidance of contributors are available from the Editor. Contributed articles usually carry the author's name when published; they should be exclusive to ENGINEERING. When an article is accepted for publication the author is normally advised of the planned publication date.

Subscription Rates
One year, inland and abroad £5 10*s* (Canada, £5 5*s*). Three months 27*s* 6*d* all countries. Single copies 2*s* 7*d* post paid.

Back Numbers
Back numbers, from recent issues to certain of the earliest issues from 1866, are available at the usual price for single copies.

Reprints
Reprints of articles which have been published in ENGINEERING can be supplied. Requests for quotations, stating the quantity required, should be addressed to the Reprints Department.

Engineering Information Service
Assistance is available from Engineering Information Service in obtaining information, and in locating sources of information, both technical and commercial. EIS deals, for example, with names of makers and suppliers of plant and equipment, technical data on design, markets for engineering products, and the compilation of references to information on specific topics. Inquiries should be addressed to Engineering Information Service, 36 Bedford Street, London, WC2.

Advertisement Rates
The rates for advertising in the classified advertisement sections (Appointments, Company Meetings, Trade and Technical) are given in those sections. The Rate Card, covering all advertisements including display, is available from the Advertisement Manager.

Foundation for a blast furnace in Refractory Concrete, cast as a cylindrical boss of 32 ft. 6 in. diameter and 9 ft. depth.

FURNACE AND BOILER FOUNDATIONS

to ensure maximum protection to the underlying structural foundations

and also

SAVE MONEY, TIME & LABOUR

use * REFRACTORY CONCRETE

USE SECAR 250
(an iron-free white calcium-aluminate cement)
for
Super Duty and Special Conditions of:—
Higher Temperatures up to 1800°C.
Reducing Atmospheres.
Resistance to Slag attack.
Resistance to products of combustion.
Write for booklet "SECAR 250".

* Refractory Concrete (stable under load up to 1350°C) is made with crushed firebrick and Ciment Fondu. Ready for any purpose in 24 hours

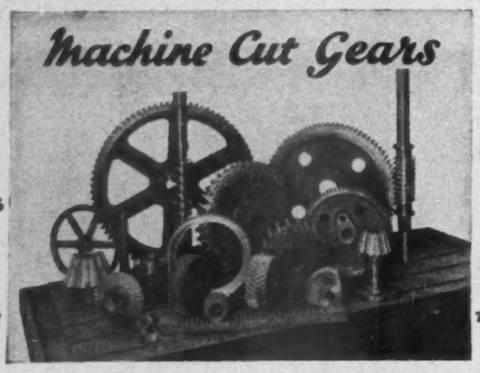
CIMENT FONDU
Regd Trade Mark
ALUMINOUS CEMENT

LAFARGE ALUMINOUS CEMENT CO. LTD., 73 BROOK STREET LONDON W.1. Tel: MAYfair 8546
AF/50

SPURS
BEVELS
WORM
WHEELS
HELICALS
CHAIN GEARS

COMPLETE SUPPLY CUTTING ONLY

Machine Cut Gears

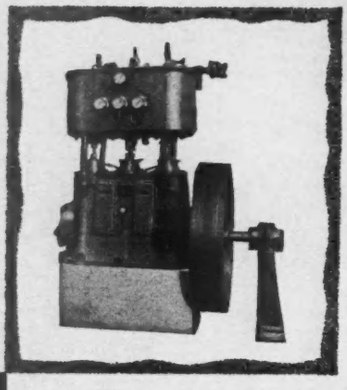


WORMS
RACKS
SCREWS
SILENT GEARS
CHANGE GEARS

ALL MATERIALS STANDARD PITCHES 7 FEET DIAMETER

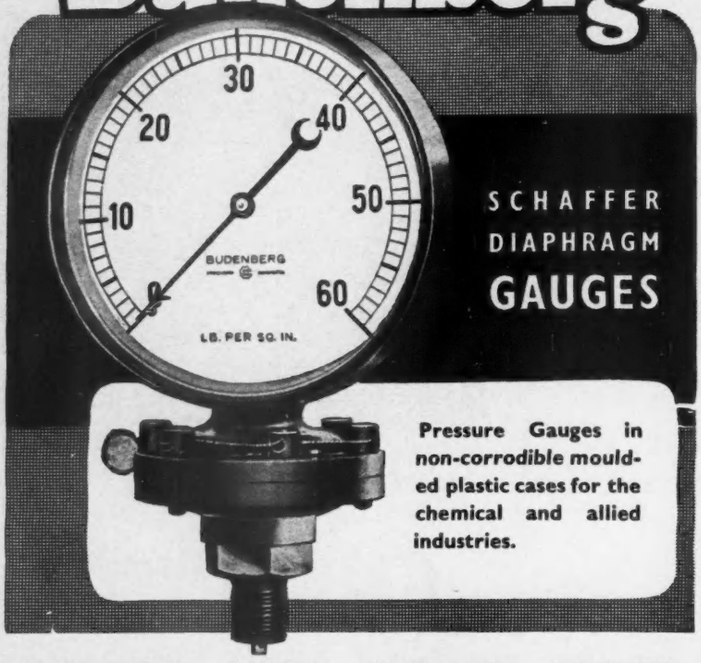
General Machine Castings made to customers' Patterns. Low Prices for Planing, Boring, Turning Screwcutting
Send your enquiries to:—
GREENWOOD'S STANDARD GEAR CUTTING CO. LTD.
New Bond Street, Halifax. Telephone: Halifax 52178 Telegrams: "Gears"

COMPRESSORS
for
HIGH PRESSURES
and
SPECIAL GASES



SEAGERS
LIMITED · DARTFORD
KENT · ENGLAND
DARTFORD 3248

Budenberg



SCHAFFER DIAPHRAGM GAUGES

Pressure Gauges in non-corrodible moulded plastic cases for the chemical and allied industries.

BUDENBERG GAUGE COMPANY, LIMITED
BROADHEATH, NR. MANCHESTER
Branch Offices: London and Glasgow

dmBU.9

TO YOUR PRECISE REQUIREMENTS

Whatever your transmission problems we design gears for any power—any speed.

More than 50 years of specialised experience at your service.

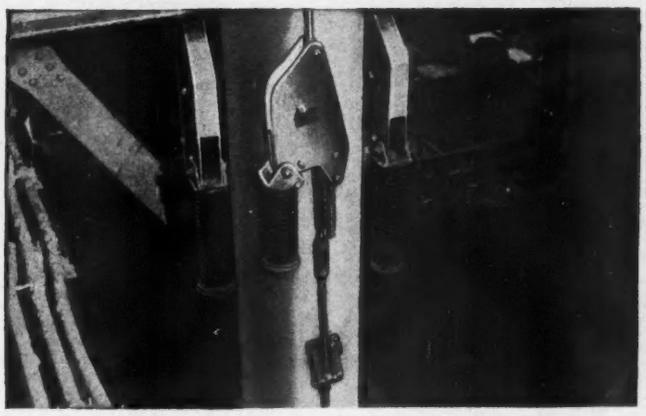
THE POWER PLANT COMPANY LIMITED
WEST DRAYTON, MIDDLESEX TEL: WEST DRAYTON 2626 (4 lines) GRAMS: ROC. WEST DRAYTON

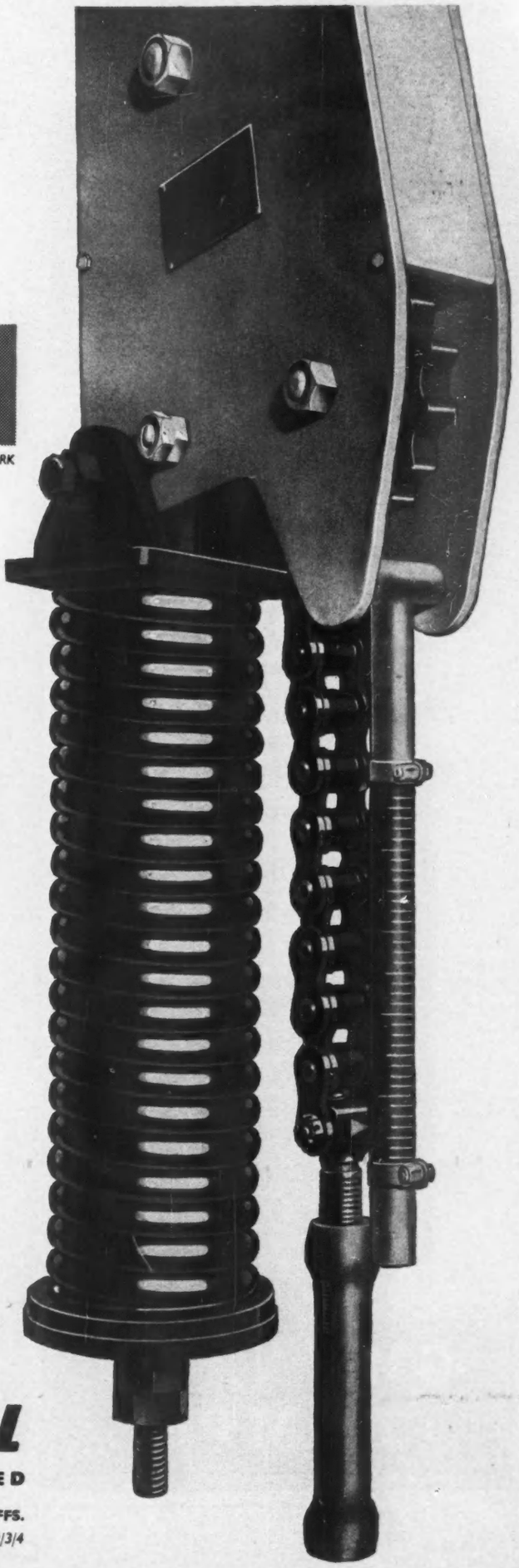
For controlled pipe movement . .

CON-TEN

REG. TRADE MARK

CONSTANT TENSION PIPE SUPPORTS





The Con-Ten sytem has not only been tested, but *proved* in industries and power stations all over the world. No matter what the load or the pipe movement, or the problems met, there is a Con-Ten to provide the most adequate and *permanent* support available. Loads from 100 lbs. to 14 tons and pipe movements up to 18 in. can be controlled by constant tension supports in the Con-Ten range.

Contact us now for full information.

British Patent Nos. 474008 720074 720075 697987 816976
U.S.A. Patent No. 2129320

BRITISH INDUSTRIAL
ENGINEERING COMPANY (STAFFS) LIMITED
CORONATION WORKS - HAINGE ROAD TIVIDALE, - TIPTON - STAFFS.
Tel. : Tipton 1222/3/4

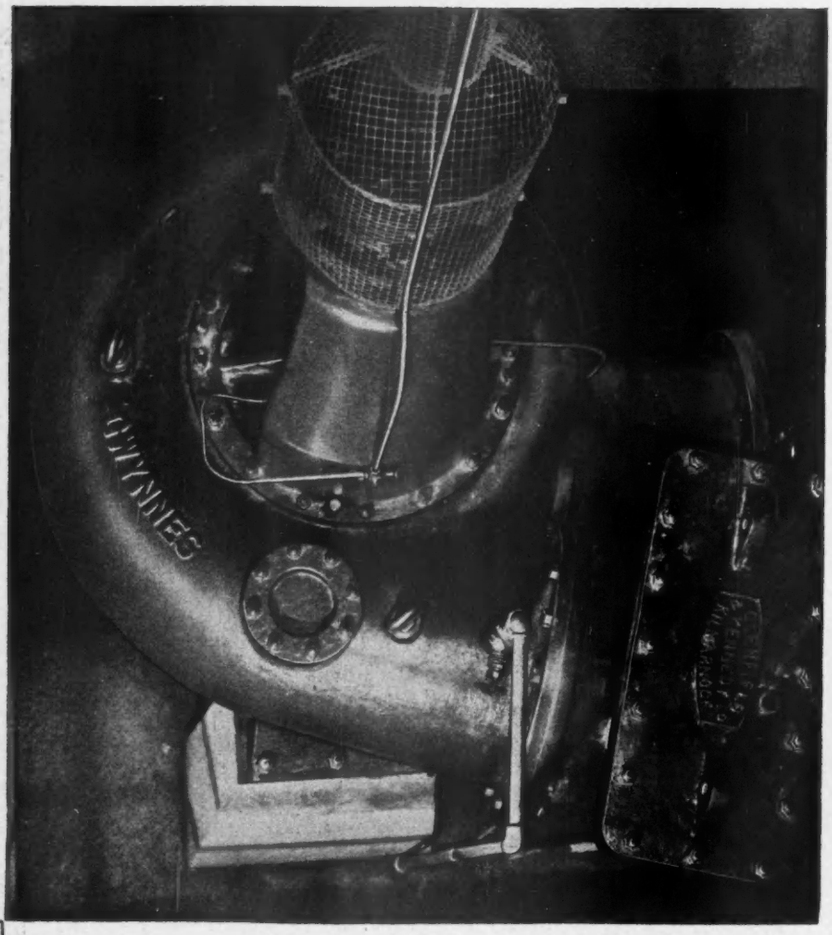
H2

Gwynnes

Sewage and Storm Water Pumps

from 3″ size upwards

The photograph shows a 16″ vertical spindle storm water pump supplied to the Borough of Taunton.



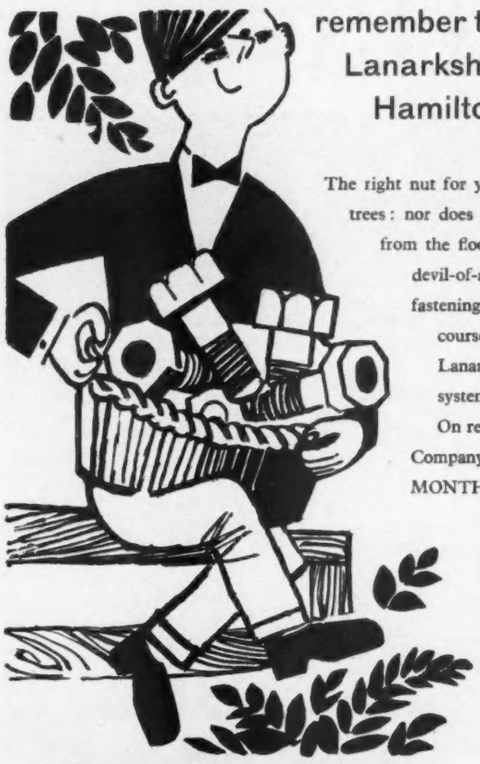
Consulting Engineer:
A. H. S. Waters, Esq.

GWYNNES PUMPS

GWYNNES PUMPS LTD
HAMMERSMITH · LONDON W.6
Telephone: RIVerside 3682 (4 lines)
Telegrams: Gwynne · Hammer · London

Centrifugal, Mixed flow, Axial flow, Single and Multi-stage, Vertical and Horizontal Spindle pumps for all purposes.

when you go gathering nuts in May, bolts in June, screws in March!... remember the number of Lanarkshire Bolt is Hamilton 1241-5



The right nut for your job doesn't grow on trees: nor does your bolt mushroom from the floor. Fact is, it's often a devil-of-a-job running the right fastening to ground. Unless of course, you know Lanarkshire. Lanarkshire Bolt run a unique system for bolt buyers.

On request, each month the Company sends you the MONTHLY STOCK LIST— a publication showing materials, sizes, threads and quantities in stock. It could save you a lot of frenzied 'phone calls when stocks run low.

LANARKSHIRE BOLT LIMITED

HAMILTON
LANARKSHIRE
Tel: Hamilton 1241-5

WET GREASE LUBRICATION TO 500°F ACHIEVED WITH

DEE M.A.G.'R'

Here is a soft grease lubrication which does not alter its consistency, has no melting point, will not sag, liquify and run—even at temperatures as high as 500°F.

These characteristics of DEE M.A.G.'R' enable you to solve many problems of high temperature lubrication inexpensively and simply—problems such as lubrication of boiler head gears, bearings on trolleys entering hot steam chambers, charging ladles in steel works.
One of our engineers will discuss your particular problem with you by appointment or, if you prefer, place an order for a trial quantity, specifying your problem.

N.B. For lubrication at temperatures up to 1000°F specify DEE 633 Refractory Lubricant.

DEE OIL COMPANY LIMITED
Delta Works, Irlam Road, Bootle, Liverpool 20
Telephone: Bootle 1897

THORNYCROFT INDUSTRIAL DIESEL ENGINES from 12½ to 200 b.h.p.

provide the power.

In PAKISTAN five 65 KVA generator sets are operated by Gammon Pakistan Limited on a building project at Kharian.

Thornycroft Industrial Engines NR6—65 KVA at 1,500 r.p.m.

Write for full particulars of our complete range.

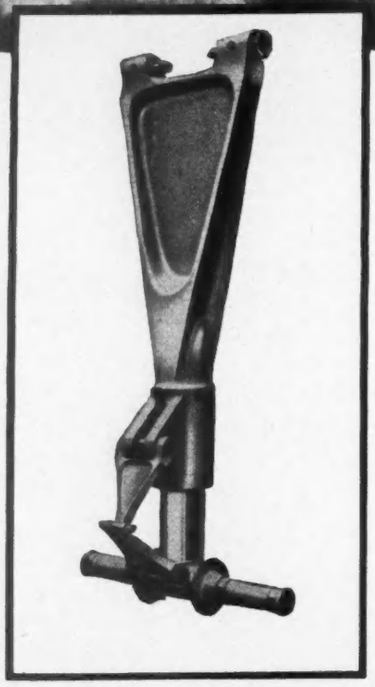
TRANSPORT EQUIPMENT (THORNYCROFT) LIMITED, READING, BERKS. Reading 71518
LONDON OFFICE: THORNYCROFT HOUSE, SMITH SQUARE, S.W.1. Abbey 8000

NICKEL ALLOY STEELS

ensure reliability in liquid springs

Weight saving is essential in aircraft designs and in choosing the steels for their retractable undercarriages, the Dowty group at Cheltenham turned to well-tried steels based on nickel, chromium and molybdenum, which offer attractive strength/weight ratios.

These steels, which are covered by S95, S97 and S99 aircraft specifications (industrial near equivalents are En24, En25 and En26 respectively), have high tensile values which permit dimensions, notably cylinder wall thickness, to be reduced to a minimum. Ductility measured in percentage elongation, remains adequate.



By utilising the better properties obtainable in more highly alloyed nickel alloy steels, dimensions can be reduced, lighter constructions produced, distortion through heat treatment minimised and reliability and economy achieved.

TYPICAL MECHANICAL PROPERTIES OF

EN26 *ARE GIVEN BELOW:*

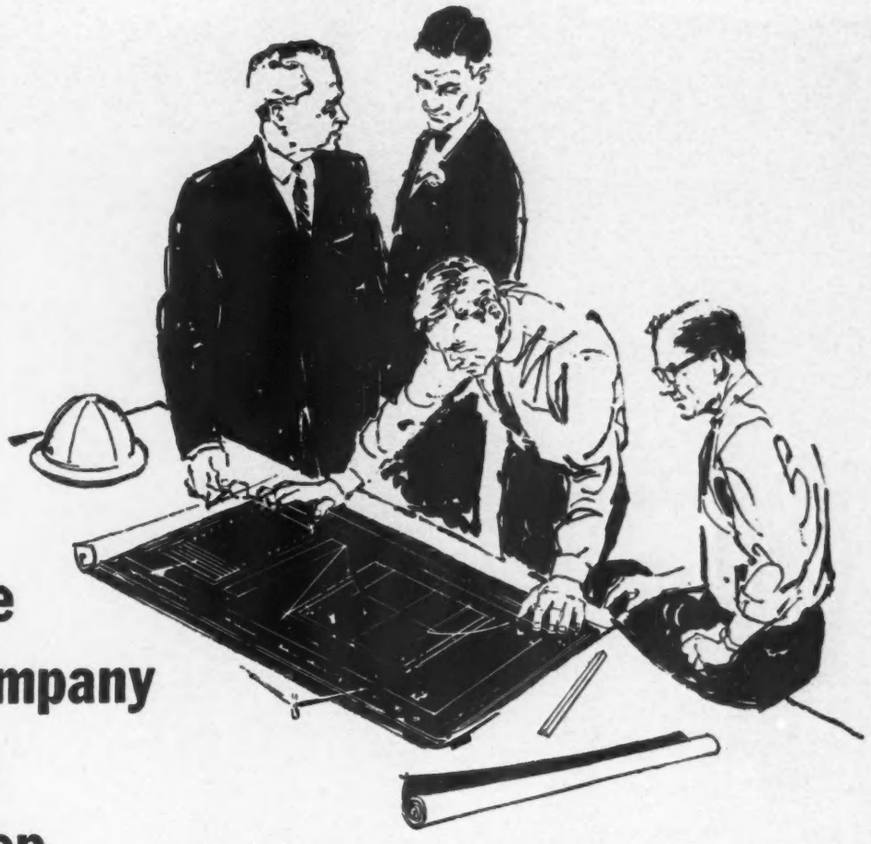
SIZE	HEAT TREATMENT	Yield Stress t.s.i.	Maximum Stress t.s.i.	Elongation per cent	Izod ft. lb.
4" sq.	Oil quenched 830°C. tempered 650°C.	64	69	20	52
2" dia.	Oil quenched 830°C.	60	70	20	53
6" sq.	Oil quenched 830°C. tempered 590°C.	62	71	18	39

Please send for our publications entitled, 'The Mechanical Properties of Nickel Alloy Steels' and 'The Case Hardening of Nickel Alloy Steels'

MOND NICKEL

THE MOND NICKEL COMPANY LIMITED · THAMES HOUSE · MILLBANK · LONDON · SW1

TGA 21/2/1A



the company we keep... We've always been proud of the company we keep. That is why we are pleased to announce the partnership between Mechans Limited and Union Tank Car Company. This enables us to offer exclusive patented features on conservation equipment through Union Tank Car Company's division—Graver Tank & Mfg. Co., East Chicago, Indiana, U.S.A.

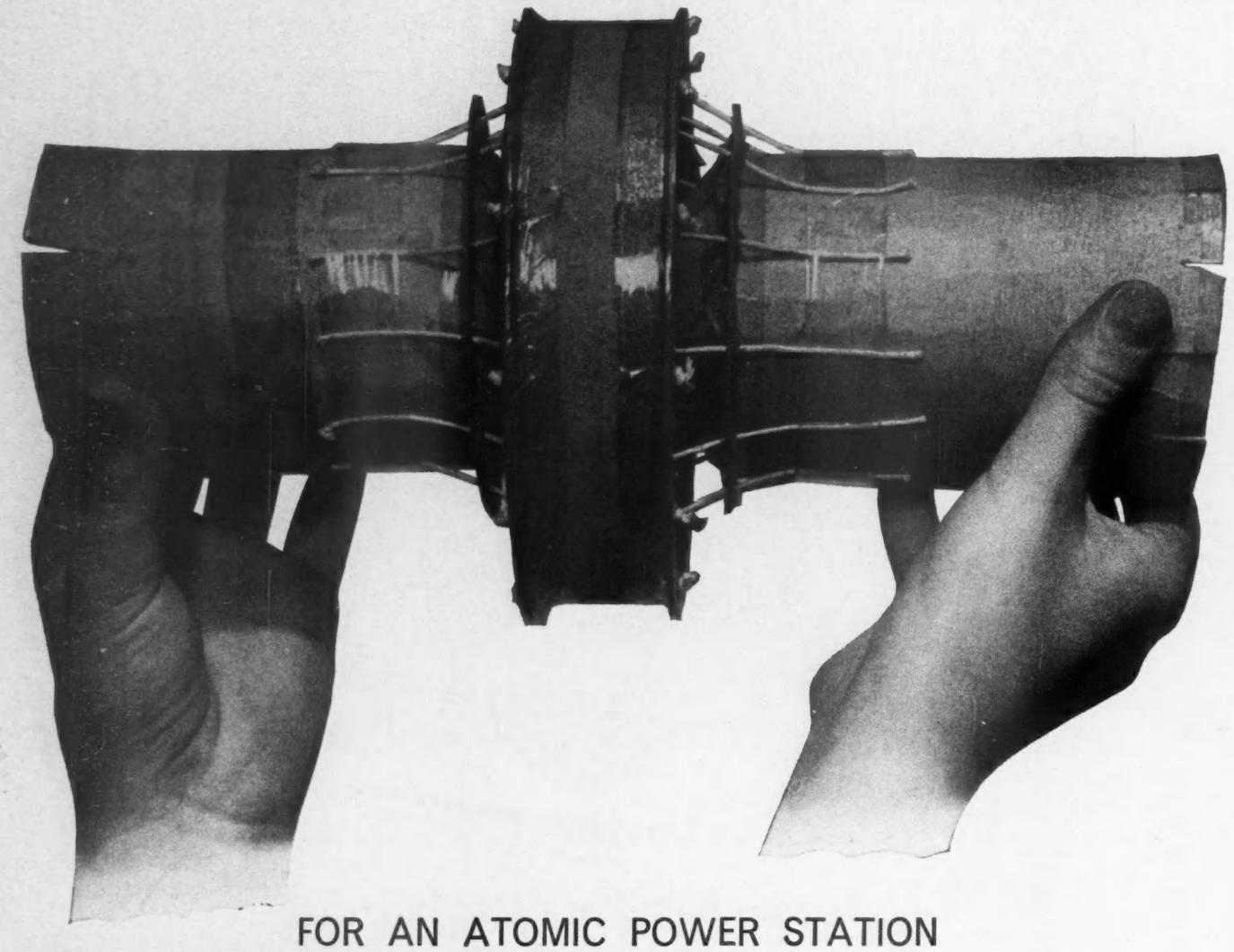
As a result of this affiliation we become a part of a world-wide network of associated companies. Merging our resources, craftsmanship and experience, especially in plate fabricating and erecting for the petroleum and chemical industries, we can give outstanding service anywhere in the free world.

The many Graver tanks . . . Graver Expansion Roof Tanks, Graver Floating Roof Tanks, Graver Pressure Storage Tanks or other specially engineered vessels . . . offer many benefits to industry.

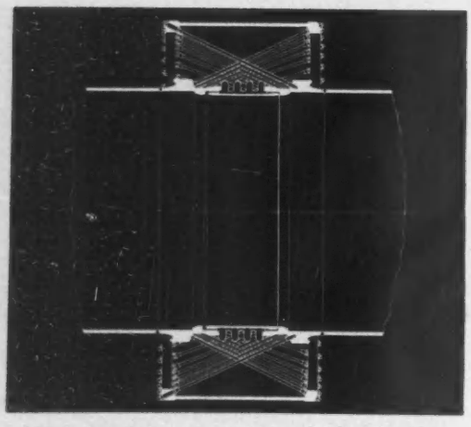
When your plans call for expansion or the building of new facilities . . . no matter where . . . call on us.

MECHANS LIMITED

HEAD OFFICE AND WORKS: GLASGOW W. 4
LONDON OFFICE: 129. KINGSWAY, LONDON, W.C. 2



FOR AN ATOMIC POWER STATION



Don't despair if you cannot immediately follow the functioning of the bar system. It took the Engineering Division several days to understand it, and the only way they could make it clear to our executives was with the cardboard model in the photograph.

With cardboard, string, the office sticky-tape and an artificial pearl borrowed from a typist (for the spherical joint between the two cones) Richardsons Westgarth engineers have knocked up a radically new solution to a very old and tricky problem – how to take up the expansion of large pipes carrying high pressures. The problem came into the design office in the specific form of the CO_2 ducting of the Trawsfynydd Atomic Power Station. Pressure 265 p.s.i.; temperature 420°C; axial thrust on any cross section over 1,000,000 lb.

The usual means of taking this thrust – on either an internal flexible tongue or an external arrangement of hinge pins, guides and rollers – are cumbersome and, worse, flexible in only one plane, so that any sideways deflection produces stresses incapable of analysis. Rollers and pins need lubrication and are subject to wear, and both disturb the uniform distribution of stress around the periphery of the pipe.

In the new Richardsons Westgarth joint the end restraint is provided by a ring of high-tensile steel bars, and flexing is taken entirely by elastic stress in these bars. The joint is thus flexible in *all* directions. No lubrication is needed; all forces are calculable – and they are fed uniformly onto the periphery of the restraint.

This is the kind of solution – unconventional, simpler, sounder and cheaper – that the fresh thinking of Richardsons Westgarth engineers is continually producing.

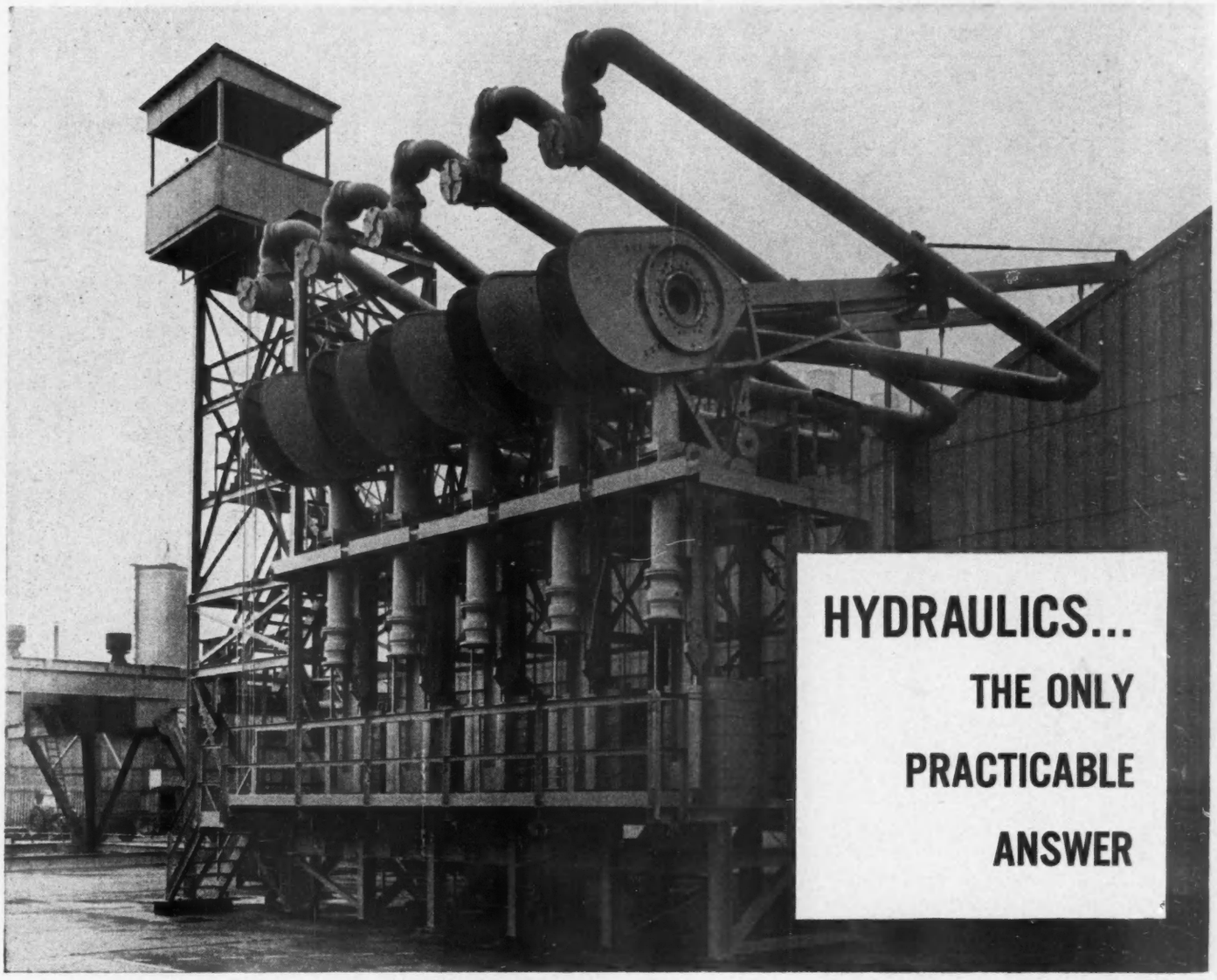
RICHARDSONS, WESTGARTH & CO LTD

R W G

The Controlling Company of the RICHARDSONS WESTGARTH GROUP Wallsend, Northumberland, and at 58 Victoria St., London, SW1

RW 67

Associated with Atomic Power Constructions Ltd.



VICKERS equipment controls massive loading arms

In an installation for loading giant oil tankers, five 12 in. diameter arms, each 52 feet long — a total weight of approximately 198,000 lb. — have to be moved from "rest", right over to the ship, a distance of 50 ft.

Each arm has to be capable of slewing 30 degrees to either side, to compensate for drift, and the positioning of the ends must be delicate to allow for coupling to the tanker. All five arms have to be individually controlled at the top of the structure. A formidable task from a single station.

The entire power actuation was accomplished by a 1500 p.s.i. VICKERS Hydraulic System, comprising pump, valves and actuating cylinders, manufactured by Stein Atkinson Vickers for the Oil Well Engineering Co. Ltd., the British Licensees for Chiksan Hydraulic Marine Loading Arms.

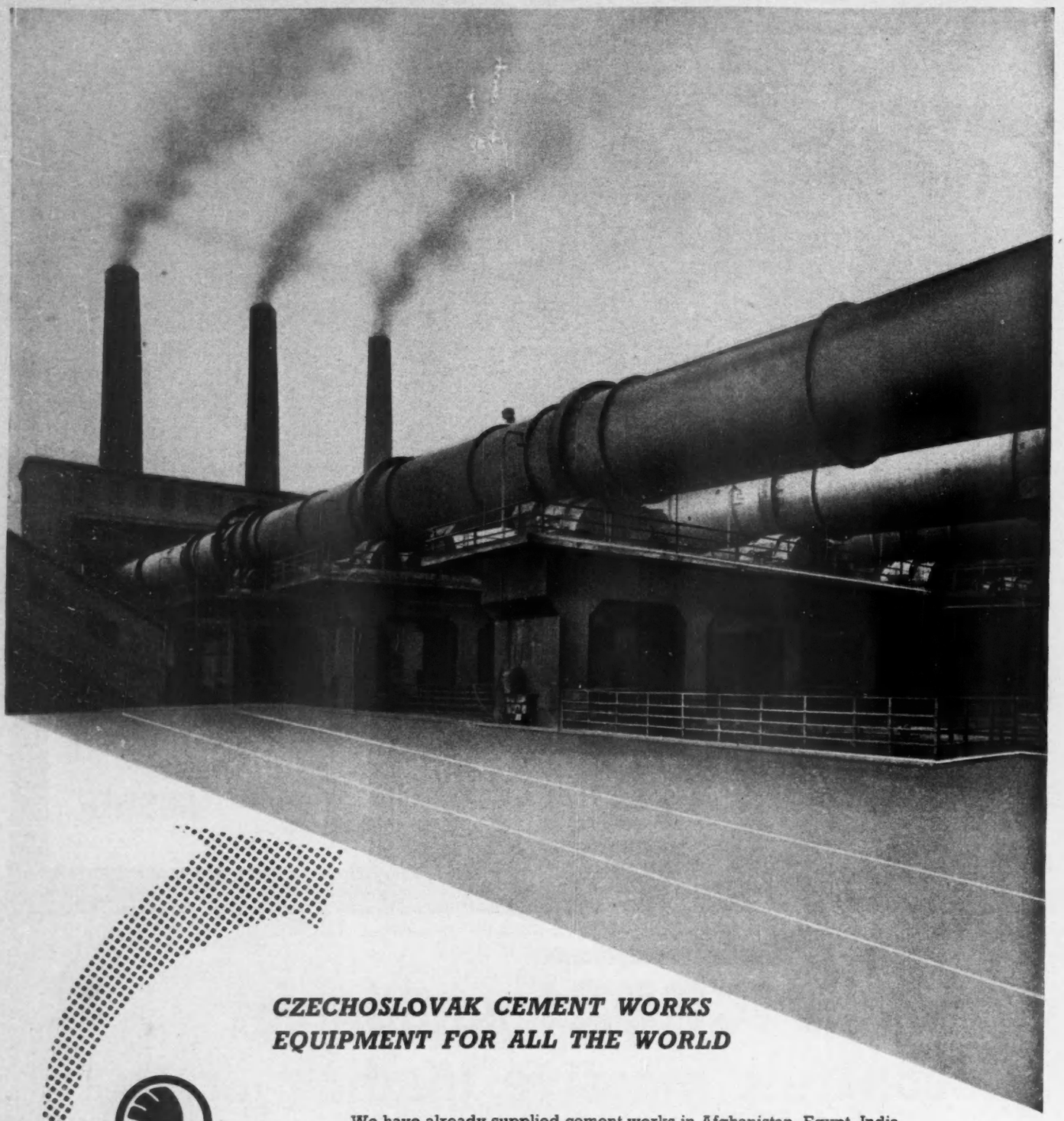
Stein Atkinson Vickers have engineered many other widely diverse applications which prove the efficiency and reliability of VICKERS Hydraulic Equipment.

STEIN ATKINSON VICKERS HYDRAULICS LTD

197 Knightsbridge, London, S.W.7 Telephone: KNIghtsbridge 9641

Technical Sales & Service at London, Birmingham, Glasgow, Leeds and Manchester

SAS 22



CZECHOSLOVAK CEMENT WORKS EQUIPMENT FOR ALL THE WORLD

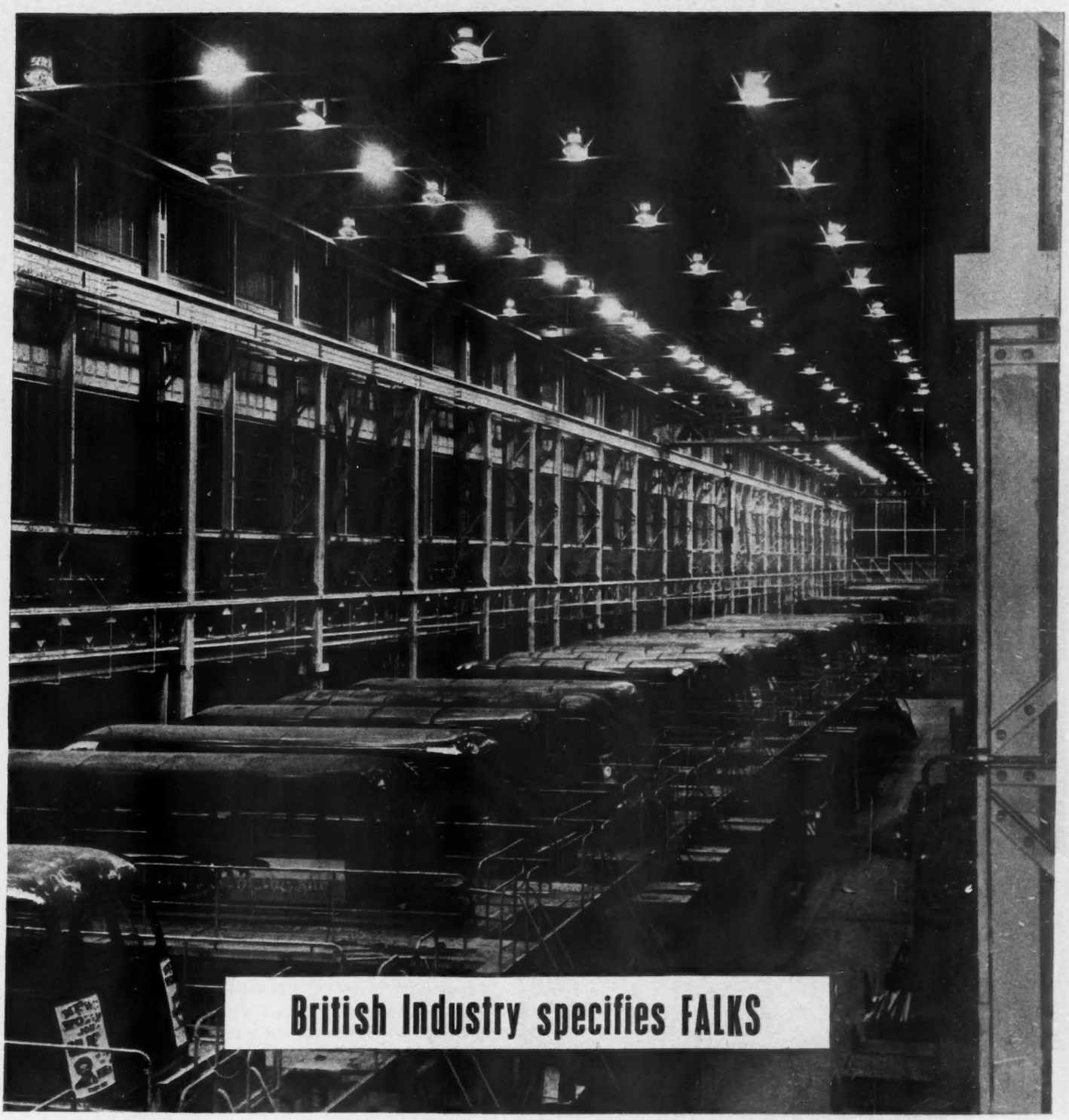
We have already supplied cement works in Afghanistan, Egypt, India, Poland, USSR, China and other countries, so confirming that we meet world-wide standards for this equipment.
Czechoslovak industry is able to design and manufacture complete equipment for cement works with rotary and shaft kilns, including all the electrical installation or using the client's own electric power plant.

Visit our display stands at the Brno International Trade Fair, 11th—25th September, 1960.

TECHNOEXPORT

Foreign Trade Corporation for Export of Complete Industrial Plants

Praha 2, Václavské nám. 56
CZECHOSLOVAKIA



High-bay lighting using high wattage tungsten lamps and metal reflectors at the Aldenham Works of London Transport Executive.
Architects : Thomas Billow, F.R.I.B.A., Architect to London Transport Executive *Architect-in-charge : K. J. H. Seymour, F.R.I.B.A.,*
Electrical Consultants : J. H. Plumes & Partners *General Contractors : Tersons Ltd.*

A FREE LIGHTING SERVICE

Our expert lighting engineers based in all principal cities of the U.K. will, without obligation, advise you on any lighting problem large or small and prepare lighting plans for your approval.

Write for Industrial Lighting Catalogue

FALKS, the long-established lighting specialists, designers and manufacturers of all types of fittings.

FALKS
FALK, STADELMANN & CO. LTD

PLANNED, EFFICIENT LIGHTING saves money all along the line

91 FARRINGDON ROAD, LONDON, E.C.1 HOLborn 7654. London Showrooms : 20/22 MOUNT STREET, PARK LANE, W.1 MAYfair 5671/2
AP 129

Keeping out of trouble..

at Hinkley Point

. . . . . under construction for Central Electricity Generating Board by the English Electric, Babcock and Wilcox and Taylor Woodrow, Atomic Power Construction Company Limited.

When Taylor Woodrow positioned this 3,900 ton caisson accurately above the tunnel being drilled under the rock below, the correct distribution of the loads to the structure as it settled on the bed of the Bristol Channel was of paramount importance.

Saunders-Roe strain gauge engineers provided a simple electrical system for measuring the loads in the spud legs.

This is but one example of the way in which Saunders-Roe foil strain gauge techniques requiring only simple electrical measuring instruments are contributing to research development and every day instrumentation over an almost boundless field of industrial activity.

For full details write to:—

SAUNDERS — ROE

STRAIN GAUGE DIVISION

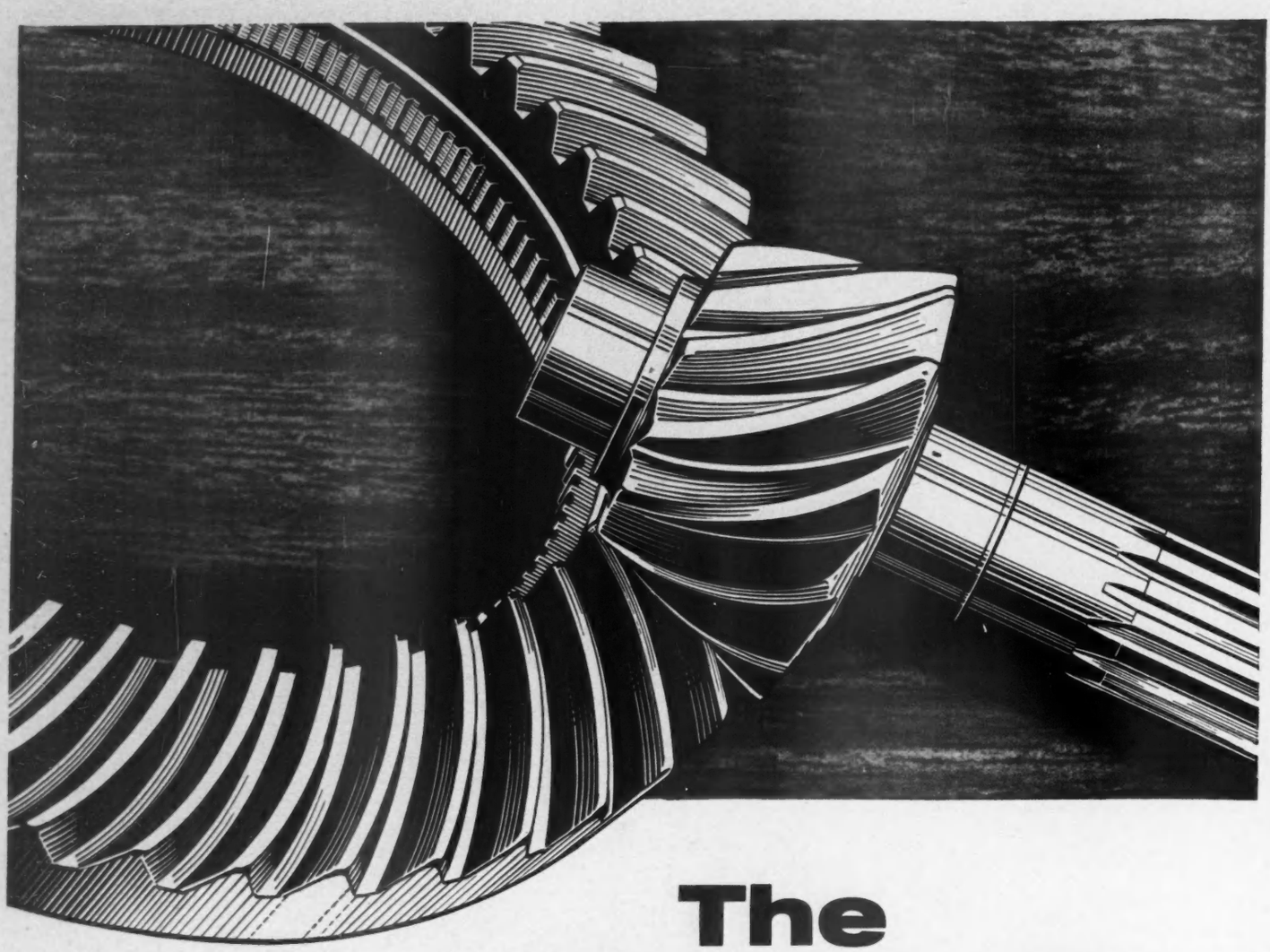
OSBORNE · EAST COWES · ISLE OF WIGHT

A member of the Westland group of companies

CRAVEN BROS.
CRANE DIVISION LTD.

MANUFACTURERS
OF ALL TYPES OF
STEELWORKS CRANES
AND HEAVY DUTY
INDUSTRIAL CRANES

CRAVEN BROS CRANE DIVISION LTD.
LOUGHBOROUGH ENGLAND
TELEPHONE LOUGHBOROUGH 2130



The right angle on the drive

E.N.V. are specialists in the design and manufacture of spiral bevel and hypoid gears, drives and assemblies, for which they have an exceptionally well-equipped plant.

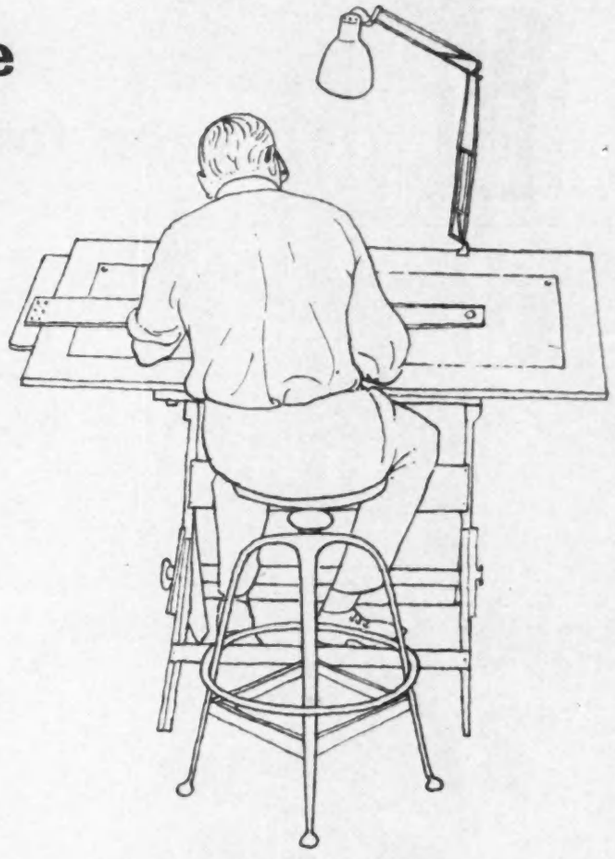
E.N.V. Engineers will be pleased to advise on problems associated with gears and drives, especially where bevel gears are used.

ENV for gears

E.N.V. ENGINEERING COMPANY LTD, Hythe Road, Willesden, London, N.W.10. Tel: LAD 3622

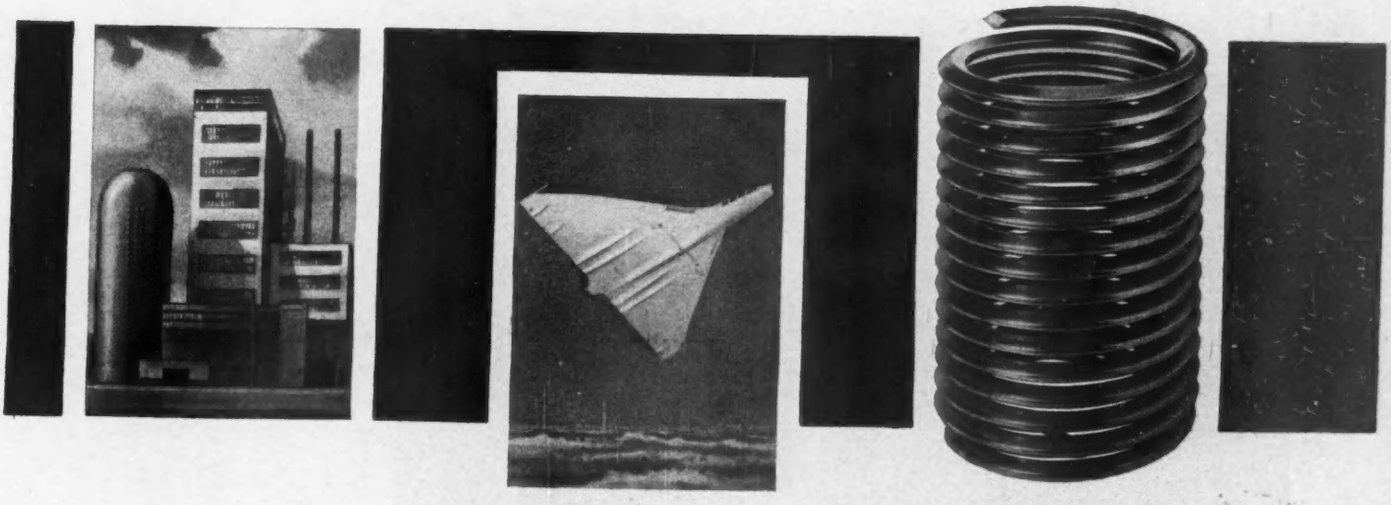
the embodiment of this scientific age

Forward-looking engineers are embodying Heli-Coil Screw Thread Inserts in their designs because competition demands that they use only today's most advanced and successful techniques. The Heli-Coil method of screw thread engineering can improve products in almost an infinity of ways . . . and at the same time make dramatic cuts in time and labour costs. It is ideal for automation, the operation is simplicity itself, just drill, tap and install. The Heli-Coil Insert provides a conventional thread with higher loading strengths and greater resistance to wear and stresses—it literally *armours* the thread. The assembly obtained is anti-vibration because the Heli-Coil Insert allows pre-stressing. Weight and space are saved and the serviceability and appearance of the product enhanced. The importance of Heli-Coil Inserts to the modern designer is an irrefutable fact. Why not have all the information in front of you—data is freely available. Ask for Sales Leaflet APC 48/E.10.



HELI-COIL*

SCREW THREAD INSERTS



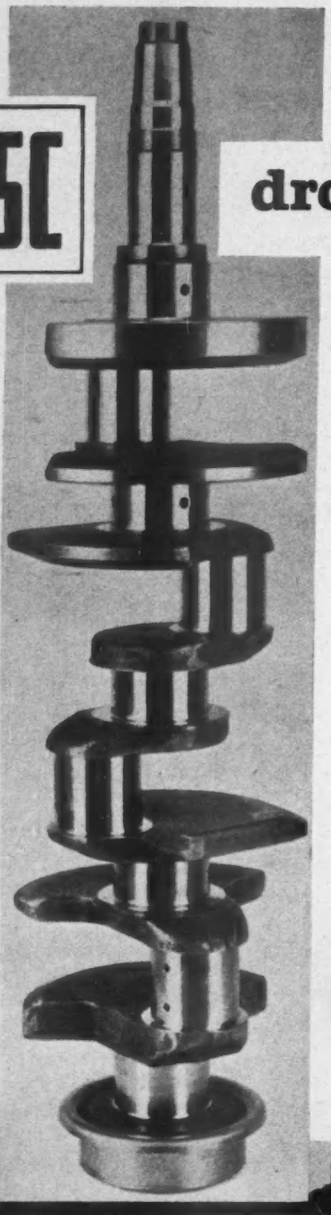
Your newest design . . . is it quite up to date?

*HELI-COIL is a registered trade mark

Write for more data on HELI-COIL inserts to **ARMSTRONG PATENTS CO., LTD., EASTGATE, BEVERLEY, YORKSHIRE**

Tel: Beverley 82212 (6 lines)

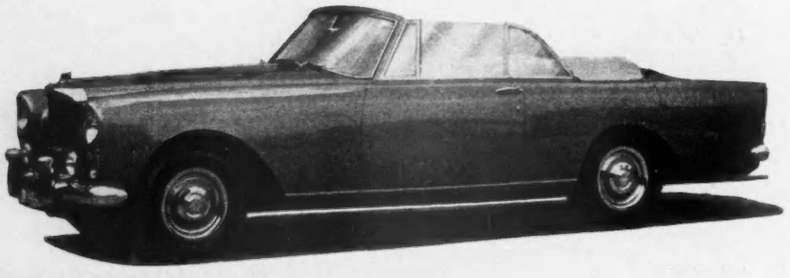
AND AT MELBOURNE, AUSTRALIA. MONTREAL AND TORONTO, CANADA.



ESC

drop forged crankshafts . . .

are used in the new $6\frac{1}{4}$ litre V.8. engine in the Rolls-Royce Silver Cloud II and Bentley S 2 Continental

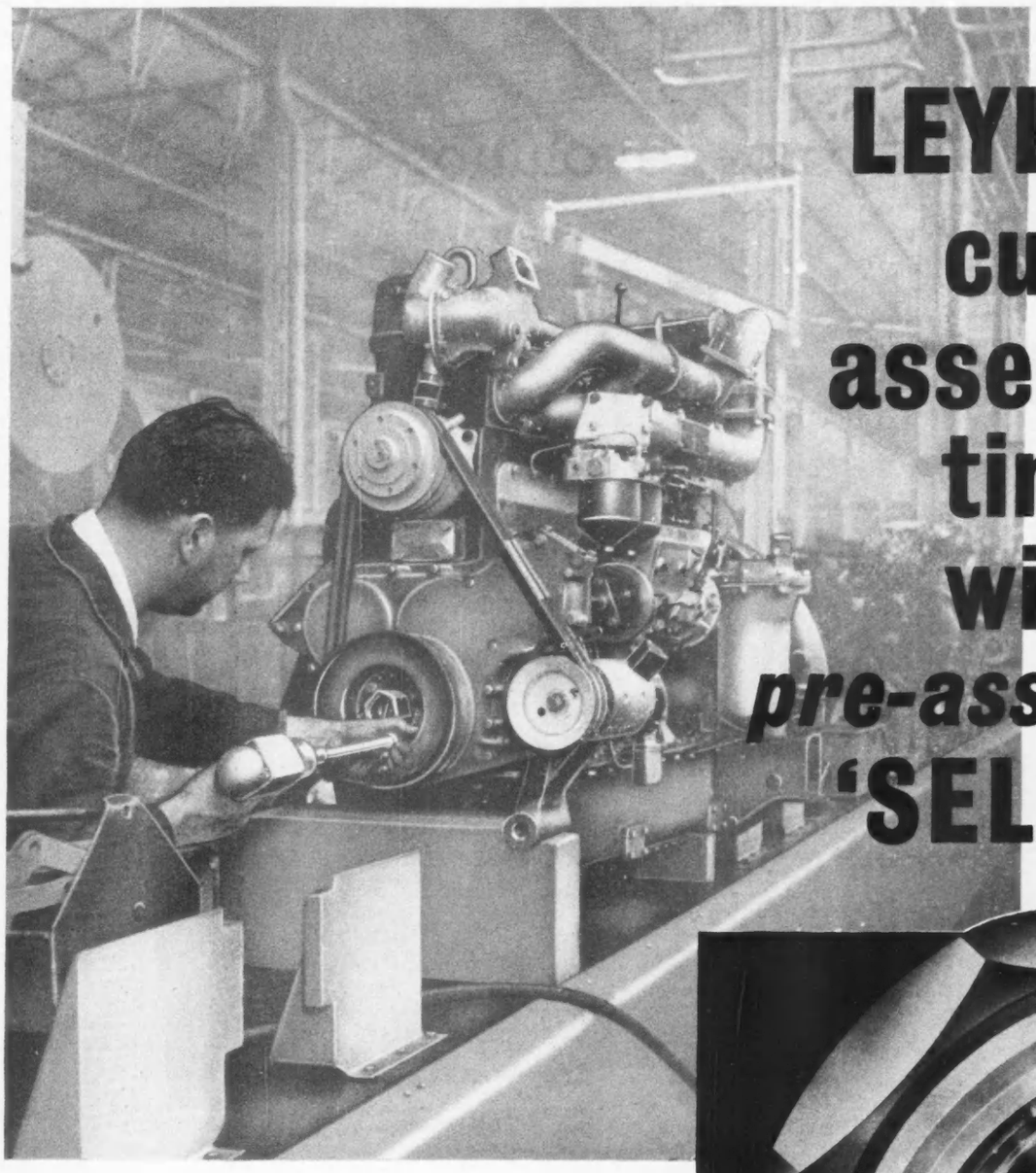


A wholly owned subsidiary of English Steel Corporation Ltd.

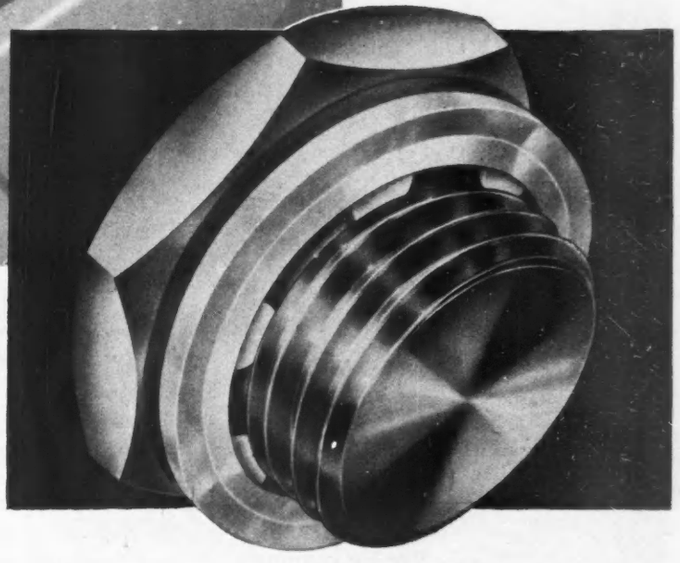
ENGLISH STEEL

FORGE AND ENGINEERING CORPORATION LTD

River Don Works, Sheffield



LEYLAND cuts assembly time with *pre-assembled* 'SELONS'



Leyland 0.350 engines are installed in the 12-ton Comet range of trucks.

For efficient sealing and speedy assembly, Leyland Motors use these pre-assembled nylon captive sealing washers.

DOWTY 'SELON'

Full range of sizes available

DOWTY SEALS LIMITED · ASHCHURCH · GLOS.

Member of the DOWTY Group

Telephone : Tewkesbury 2271

A rotor revolution

depends on these gears

Since Holroyd brought rotor-making to a fine art, more and more high lead angle rotors are being used for pumps, compressors, blowers and meters. These rotors are designed to run with very fine clearances and are usually coupled by spur or helical timing gears, which must be produced with the highest possible accuracy in order to maintain, throughout each complete revolution of the rotors, the fine clearances without actually making contact.

Profile ground spur and helical gears:

We are now in a position to supply profile ground spur or helical gears of a very high order of accuracy, particularly in regard to accumulative pitch errors, which are so important on timing gears. Test charts can be supplied if you wish. Our capacity for such gears is up to 11½ inch diameter, 3½ inch face width, 4 to 20 D.P.

Holroyd

JOHN HOLROYD & CO. LTD.

MILNROW · LANCASHIRE

CBC A4

Complete feed heating and deaerating plant for a 60 MW turbo alternator

Condensing and Feed heating Plant

Hick Hargreaves, having specialised in the design and production of condensing and feed heating plant for over forty years, now rank as one of the largest independent manufacturers in the country. Improvement in design and production facilities have fully kept pace with the increase in size and complexity of plants, made necessary by the rapid progress which has taken place in the generation of electricity.

Many Hick Hargreaves condensers up to 75,000 KW. capacity have been in operation for more than 25 years. A number of 120,000 KW. units are under construction and designs have been developed for units of 550,000 KW.

Hick Hargreaves

AND COMPANY LTD · BOLTON

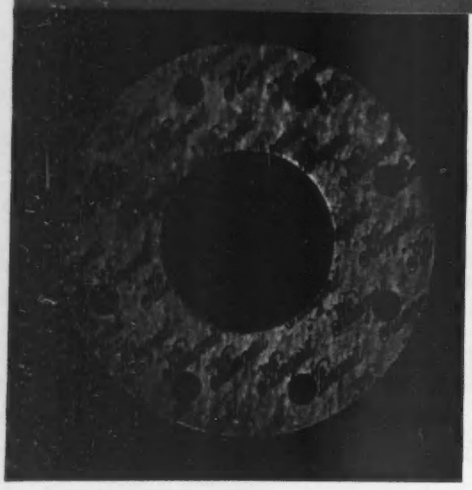
Serving Industry without fail..

Klinger

THERE is no substitute for experience—and in the field of modern jointing materials the experience of Richard Klinger Ltd. is unrivalled. As long ago as 1886, they pioneered the original compressed asbestos jointing known as 'Klingerit'—a tremendous advance in those days, it is still in the widest use today for ships, refineries, chemical and power plants all over the world. Please write for the Klinger book of jointings and full details.

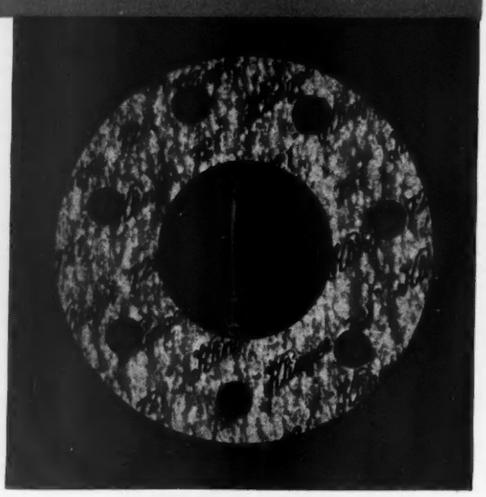
JOINTINGS

First in 1886 foremost today—
Klinger Jointings in use throughout the world.



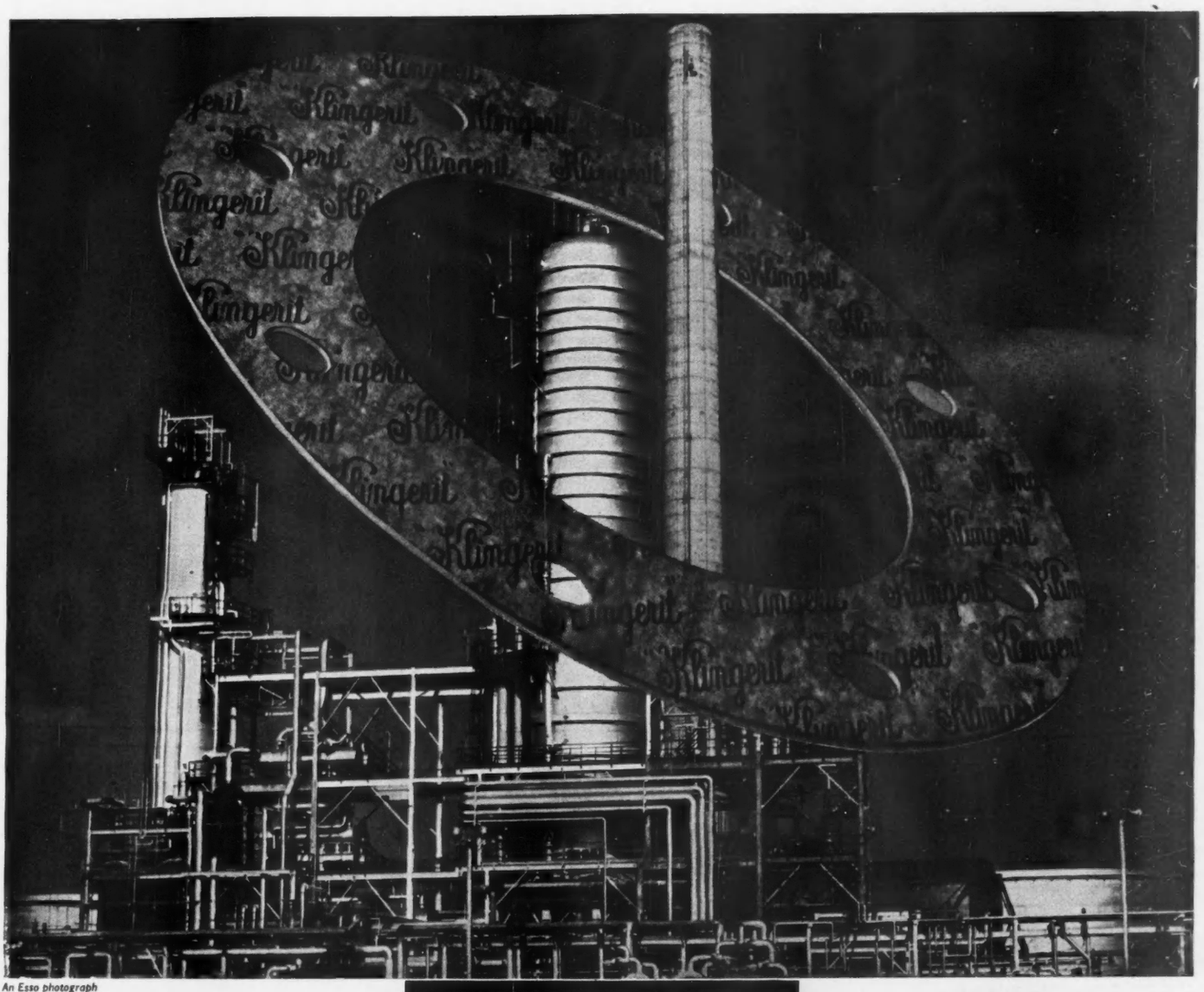
KLINGERIT
High-pressure compressed asbestos sheet jointing

KLINGER 1000
Wire-reinforced jointing



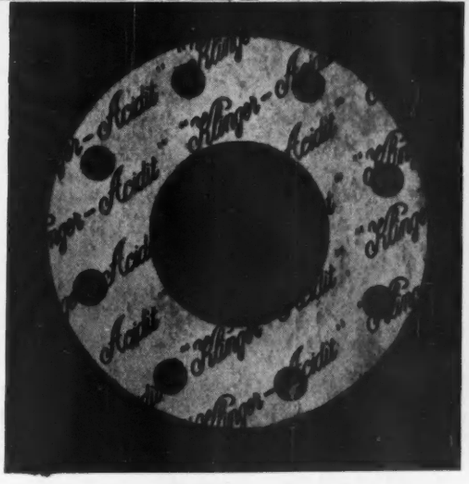
KLINGER 721
Oil-resistant compressed asbestos jointing for the Aircraft Industry

RICHARD KLINGER LIMITED ***Klingerit Works***

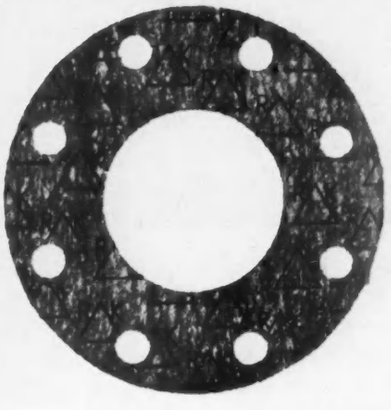


An Esso photograph

KLINGER OILIT
Jointing especially made for use with oils and all hydro-carbons



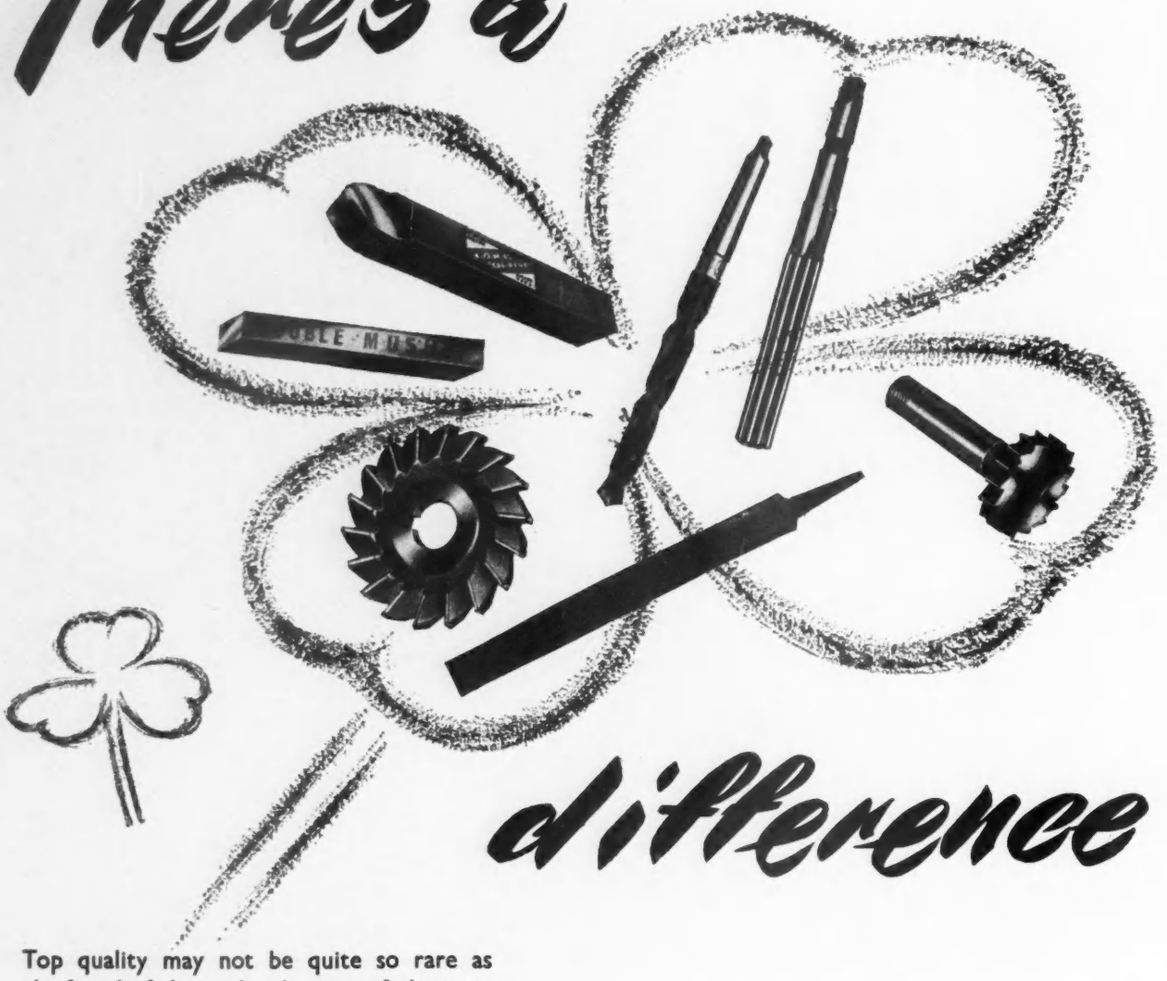
KLINGER ACIDIT
The acid-resisting compressed asbestos jointing



R.K.
Steam and Oil jointing

SIDCUP, KENT ***Telephone FOOtscray 7777***

There's a



difference

Top quality may not be quite so rare as the four leaf clover, but be sure of obtaining the best by specifying *Osborn* engineers' cutting tools. The range available includes almost every type of engineers' cutting tool, and these are manufactured throughout from steelmaking to finished product within the same organisation.

Comprehensive stocks constantly maintained.

MUSHET BRANDS ENGINEERS' CUTTING TOOLS

- *Twist Drills*
- *Reamers*
- *Milling Cutters*
- *'Titanic' Chucks*
- *Lathe and Planer Tools*
- *Toolholder Bits*
- *Hand Chisels*
- *Pneumatic Snaps and Chisels*
- *'Hand & Heart' Files*
- *Hacksaw Blades*
- *Taps and Dies, etc.*

OSBORN

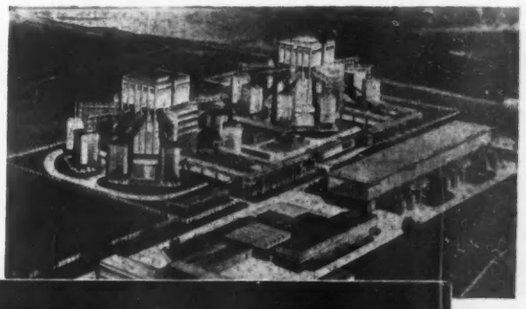
SAMUEL OSBORN & CO., LIMITED

CLYDE STEEL WORKS, SHEFFIELD.

FINE STEELMAKERS STEELFOUNDERS ENGINEERS TOOLMAKERS

ad

BERKELEY
(A.E.I. — John Thompson Nuclear Energy Co. Ltd.)

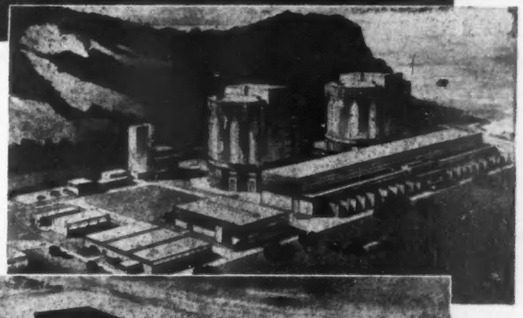


in

BRADWELL
(The Nuclear Power Plant Company Ltd.)

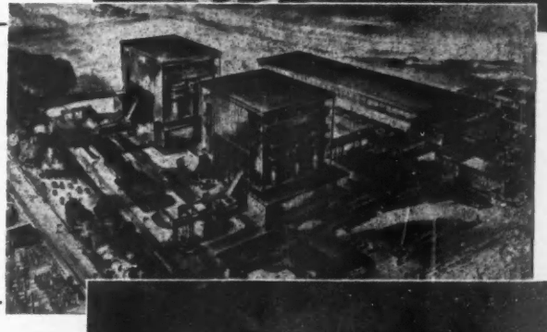
fi

HUNTERSTON (G.E.C. — Simon-Carves Group)



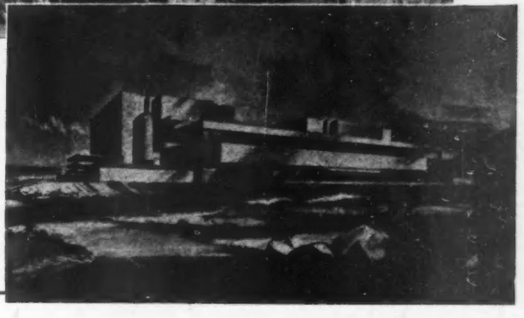
ni

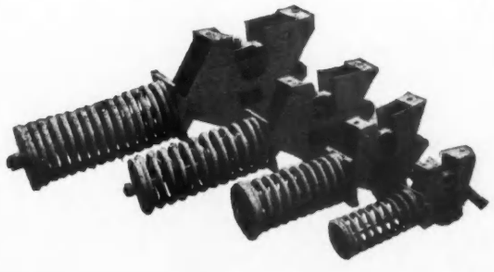
HINKLEY POINT
(English Electric, Babcock & Wilcox, Taylor Woodrow Atomic Power Group)



tum

TRAWSFYNYDD (Atomic Power Constructions Ltd.)
(An impression by Sir Basil Spence, Consultant Architect to Nuclear Civil Constructors, showing how the design blends into the landscape of Snowdonia)





Vokes Genspring constant support hangers—capable of supporting loads up to 97,800 lb. and travels up to 12″—have been specified by all five members of the Nuclear Consortia for each of the first five Nuclear Power Stations. Gensprings have already been installed at Calder Hall A & B and Chapel Cross A & B where their success in handling the movement of piping caused by temperature changes is rapidly making them an automatic choice for pipework support in the construction of Nuclear Power Stations.

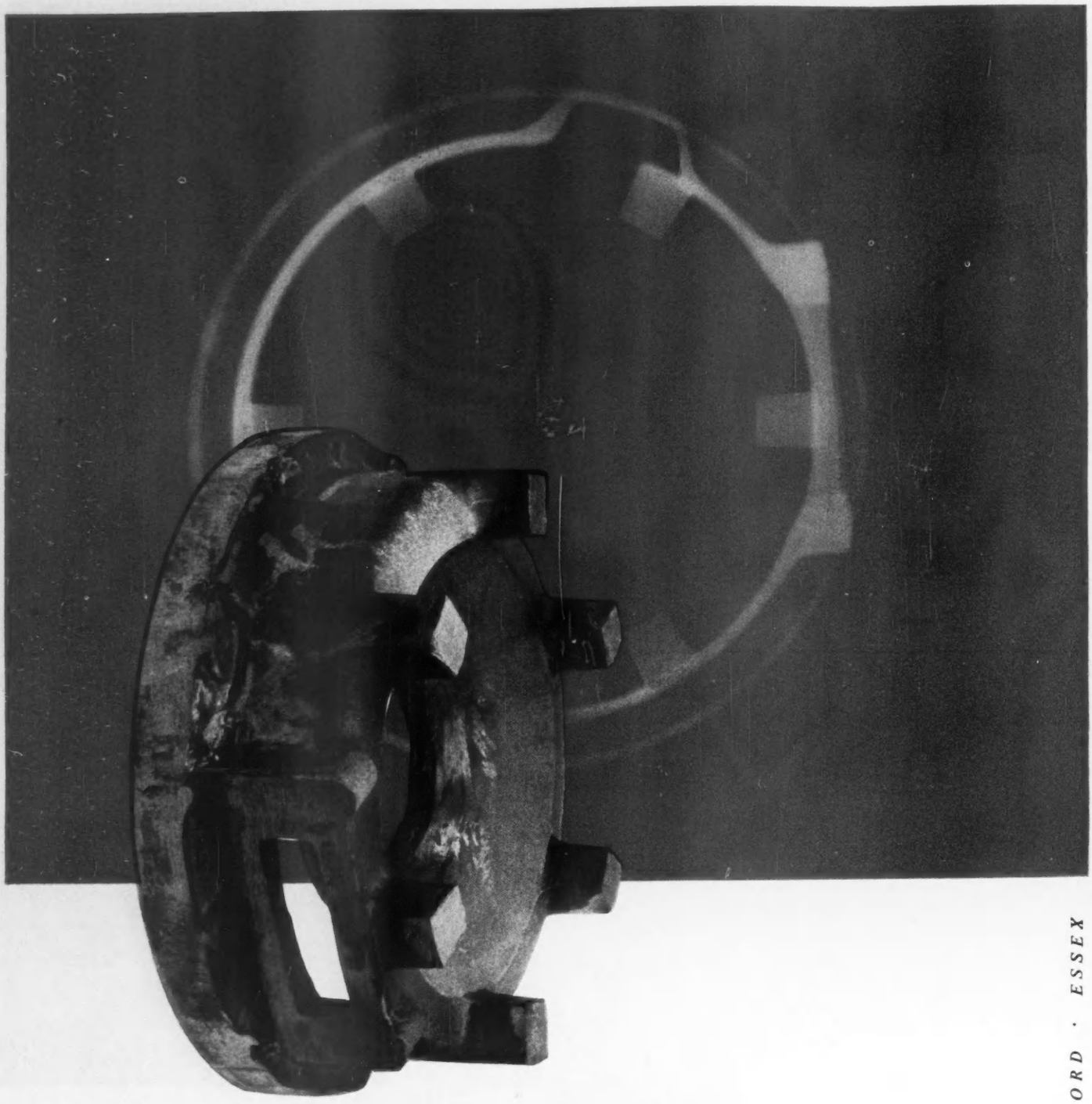
Vokes Genspring SUSPENSION SYSTEMS

VOKES GENSPRING LIMITED · GUILDFORD · SURREY

Telephone: Guildford 62861 (6 lines) Telex: 8-535 Vokesacess, Guildford Telegrams & Cables: Vokesacess, Guildford, Telex

A member of the VOKES Group

VG46



for fine grain and better definition—

Outstanding for its exceptionally fine grain, ILFORD CX is a high-contrast film of medium speed. It can be used with or without lead screens, for industrial radiography up to two million volts, and for gamma radiography. It is ideal for those applications where superior definition is preferred to speed, particularly for the examination of light metal and steel castings, and for the inspection of welds. Recommended developer is Phenisol—based on Phenidone, an Ilford discovery—which gives high effective film speed and promotes contrast, without accentuating grain.

The name PHENIDONE is a registered trade mark

ILFORD *CX* **industrial X-ray film**

ILFORD LIMITED · ILFORD · ESSEX

A Spiral Casing designed by Boving & Co. Ltd. for the Central Electricity Generating Board's Hydro-electric Power Station at Cwm Rheidol, Wales.

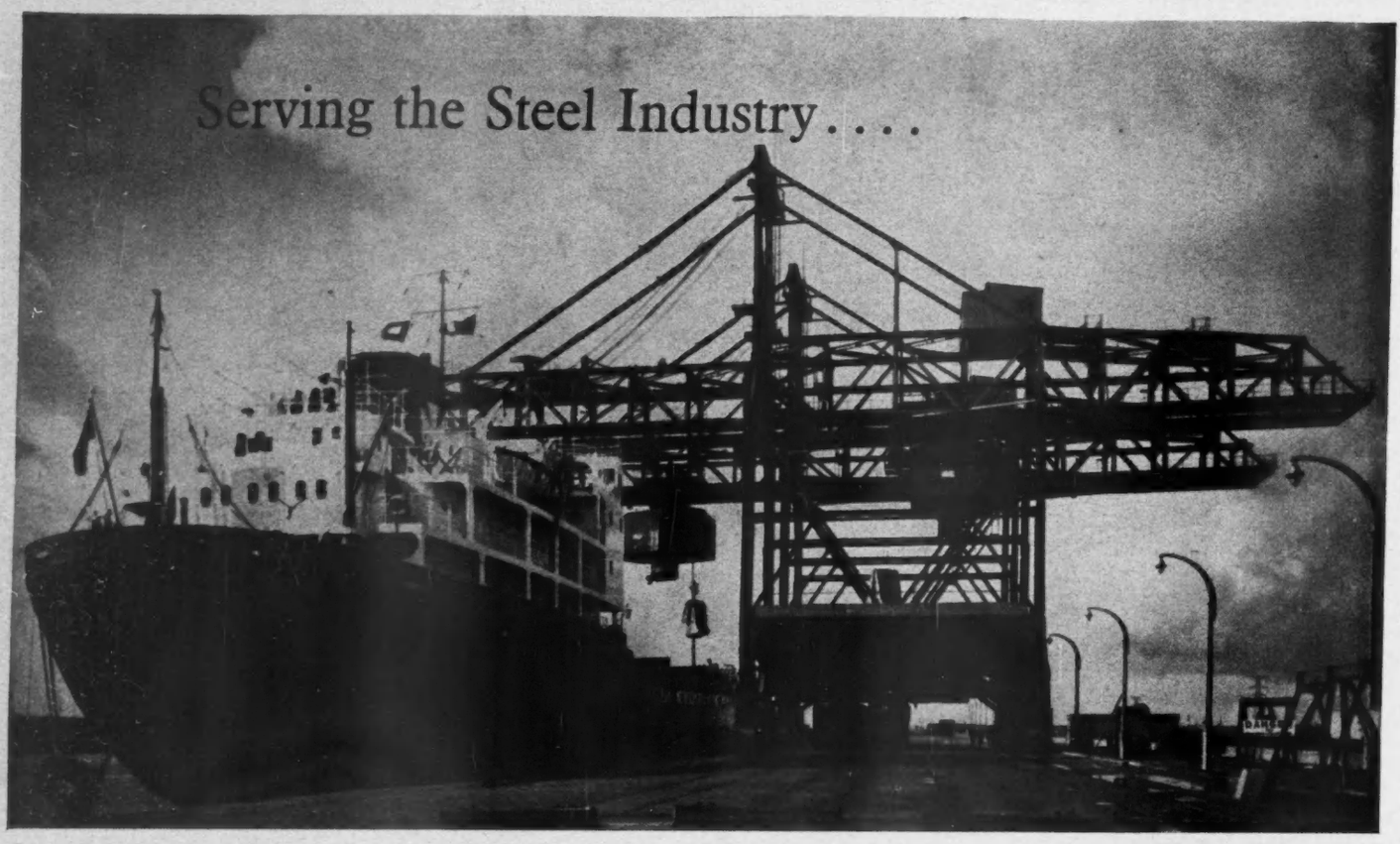
Peter Brotherhood Ltd. have the capacity, backed by skill and experience, to build prototypes, pilot plant and full scale production machines for new projects or enterprises.

PETER BROTHERHOOD LTD

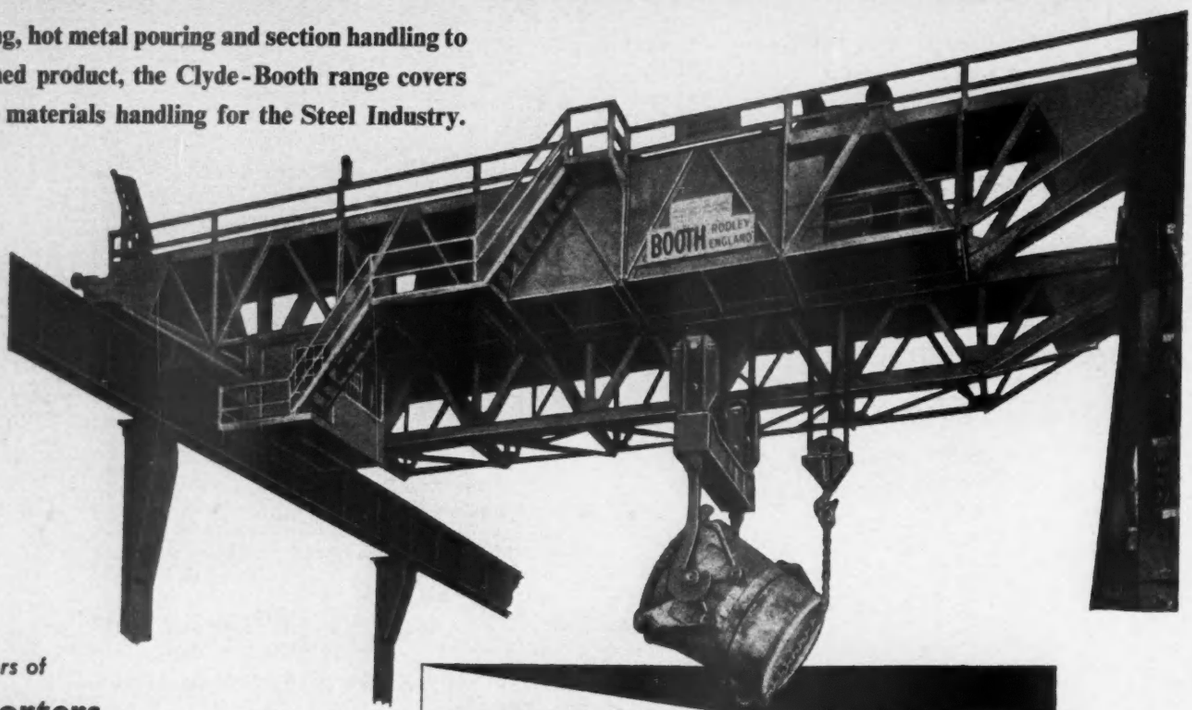
PETERBOROUGH ENGLAND

Compressor and power plant specialists for nearly a century

K



From ore unloading, hot metal pouring and section handling to shipping the finished product, the Clyde-Booth range covers the field of heavy materials handling for the Steel Industry.



Manufacturers of

Ore Transporters
Steelworks Cranes
Diesel Rail Cranes
Docksides Cranes etc.

CLYDE BOOTH

CLYDE CRANE & BOOTH LTD.

Incorporating:

Joseph Booth & Bros.,
Union Crane Works, RODLEY, Leeds.
Telephone: Pudsey 3168 (6 lines)
Grams: Cranes Rodley Telex
Telex: 55159

Clyde Crane & Engineering Co.,
MOSSEND, Lanarkshire.
Telephone: Holytown 412 (6 lines)
Grams: Clyde Motherwell Telex
Telex: 77443

SUMO PUMPS PUMP PUMP PUMP PUMP AND PUMP

Sumo submersible pumps are second to none. This has been proved in the most exacting conditions all over the world. *And they are backed by a superbly efficient after-sales service.*

SUMO PUMPS LTD., SCHOMBERG HOUSE, 82 PALL MALL, LONDON, S.W.1
Telephone: TRAfalgar 1954

(A subsidiary of Stone-Chance Ltd.— makers of Austinlite electrical specialities and Stone-Chance lighthouses)

JOHN FRASER AND SON LIMITED
Ferry Street, Millwall, London, E.14
Makers of
Pressure Vessels, Rotary Furnaces
Etc., in RIVETED or WELDED MILD STEEL PLATES

Telephone: EASt 1185 *Telegrams: Pressvessals, Phone, London*

Valves, Cocks & pipe line fittings from Stock

PEGLER & LOUDEN LTD
54 BROWN STREET GLASGOW
113 NEW BRIDGE STREET NEWCASTLE
87 SHAW STREET LIVERPOOL

The first thought in protection...

Whatever the danger—in this case fire—the choice of protection must always be conditioned by two controlling factors . . . efficiency and dependability! Essential factors—factors that have won the name of Walter Kidde an unrivalled reputation for quality in fire-fighting equipment!

For constantly, Kidde's many fire detection systems and extinguishing equipment are put to positive, practical test . . . and consistently, precision and reliability have proved their worth! Perhaps one day, the fire fighting equipment you have purchased, or are about to purchase, will stand between you and ruin or loss of life. With life and livelihood at stake, you *must* be sure. With Kidde equipment, you *can* be sure . . . *sure* of quality . . . *sure* of protection.

Kidde are specialists in inert gas systems employing carbon dioxide, nitrogen, CF_3BR, products of combustion, and argon. Manufacturers of fire detecting systems and portable fire extinguishers—they have manufacturing facilities in the U.S.A., Argentina, Australia, Brazil, Canada, France, Germany, Italy, Japan, Mexico . . . and 500 Recharging Service Stations throughout the world.

THE WALTER KIDDE CO. LTD., NORTHOLT, MIDDX. TEL: VIKING 6611.

...the last word in quality K Kidde

K2

Put NEWTHERM to any test!

NEWTHERM Calcium Silicate insulation manufactured solely by NEWALLS is the most versatile material you can use for application up to 1400°F. Try it. Put a sample section or slab on part of your plant and *prove for yourself* its outstanding ability to withstand impact and water damage.

LIGHTNESS

Weight - for - weight, NEWTHERM compares favourably with many materials far inferior in thermal efficiency and strength. This light weight is evidenced in the handleability of NEWTHERM, which even in the largest sections can easily be carried in one hand.

MOISTURE RESISTANCE

You can immerse NEWTHERM in water and its strength remains largely unimpaired. Nor does it become deformed when in contact with moisture, thus work-in-progress need not be covered. Wherever damp or humid conditions pertain, NEWTHERM is the logical material to use.

STRENGTH

Of major advantage on remote sites, NEWTHERM is unusually strong and rigid, and can withstand rough handling in transit and erection. In the case of vulnerable large-diameter sections, the hard surface offers excellent protection.

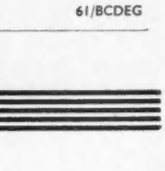
EASY APPLICATION

Supplied in pre-formed sections and slabs, NEWTHERM is available in a wide range of standard sizes (and also as plastic). The smooth surface and straight edges permit easy and speedy fitting, with minimum joints and neat finish.

NEWALLS (Reg'd Brand)

NEWTHERM calcium silicate insulation

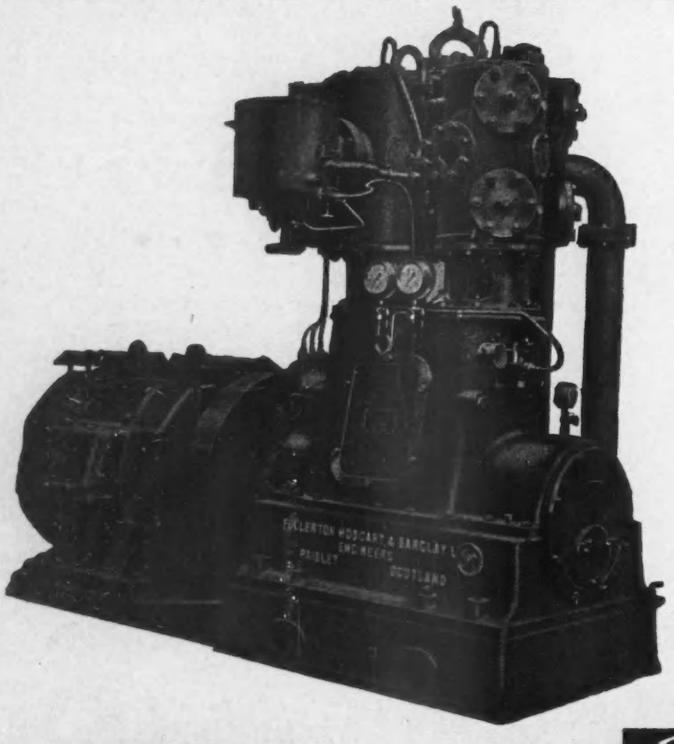
Please ask for your copy of the NEWTHERM booklet. Packed with information on limiting temperatures, thermal conductivity, compressive strength, applicational details, etc., it's a must for your bookshelf. Copies available from sole manufacturers—NEWALLS



NEWALLS INSULATION CO. LTD.
Head Office: WASHINGTON, CO. DURHAM, ENGLAND.
A member of the TURNER & NEWALL ORGANISATION

Offices & Depots at: LONDON, GLASGOW, MANCHESTER, NEWCASTLE UPON TYNE, BIRMINGHAM, BELFAST, DUBLIN, BRISTOL & CARDIFF.
Agents and Vendors in most markets abroad.

61/BCDEG



Makers of all kinds of
Steam and Motor Driven
Air & Gas Compressors
and
Hydraulic Plant

Illustration shows
Motor - Driven, Two - Stage, Double - Acting
Air Compressor
Capacity 500 cub. ft. free air per minute to a pressure of 100 lbs. per sq. inch. R.P.M. 360.

Fullerton, Hodgart & Barclay Ltd.,
VULCAN WORKS
PAISLEY, SCOTLAND
ESTD. 1838

VERSATILITY!

Not surprise—just modest pride! We must confess to a similar feeling every time yet another example of the amazing versatility of TUFNOL is confirmed.

Bearings for ships' rudders and propeller shafts, runners for Arctic sledges, seat rollers for the Oxford University Boat, insulators for high voltage switchgear, slideways for machine tools, control pulleys for aircraft, bearing bushes for motor cars, gears for textile looms—these are but a few of the many varied ways in which TUFNOL is being used to overcome problems of design, production or maintenance.

TUFNOL is a laminated plastics material of such versatility that no engineer can afford to ignore it.

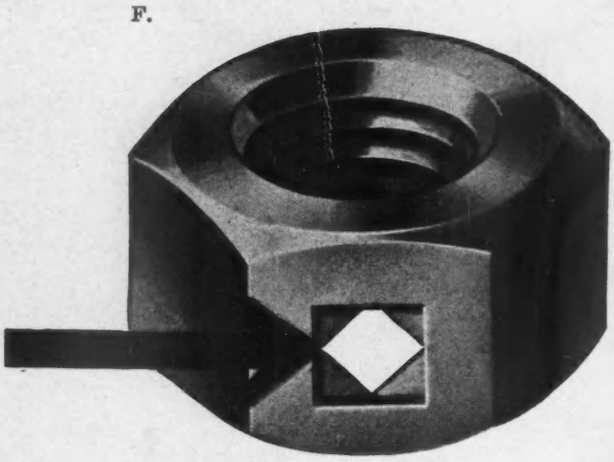
STRONG BUT LIGHT
RESISTS CORROSION
WITHSTANDS CLIMATIC EXTREMES
ELECTRICAL INSULATOR
MACHINES EASILY
STORES INDEFINITELY

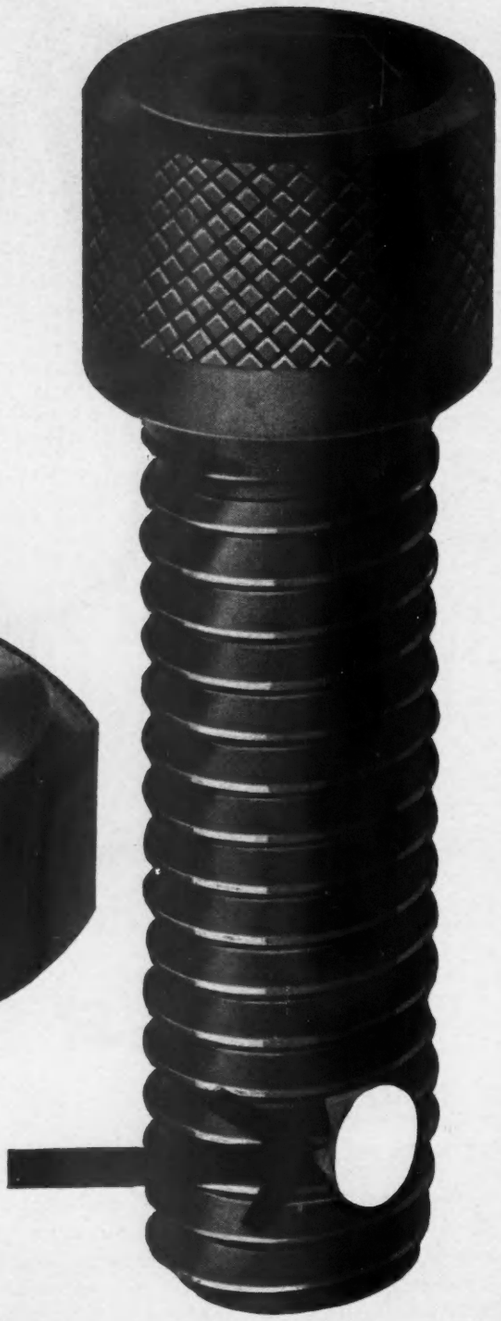
VERSATILE **TUFNOL**
(REGD. TRADE MARK)

Available in sheets, tubes, rods, angles, channels and in numerous brands

TUFNOL LTD · PERRY BARR · BIRMINGHAM 22B
379

This is the pellet
that locks the fastening
permanently
against shock and vibration:
in any position;
and without reducing
its strength.
Made of tough
resilient nylon,
Wedglok is quite
unaffected by moisture,
solvents, age,
or temperatures
between –70°
and +250°
F.





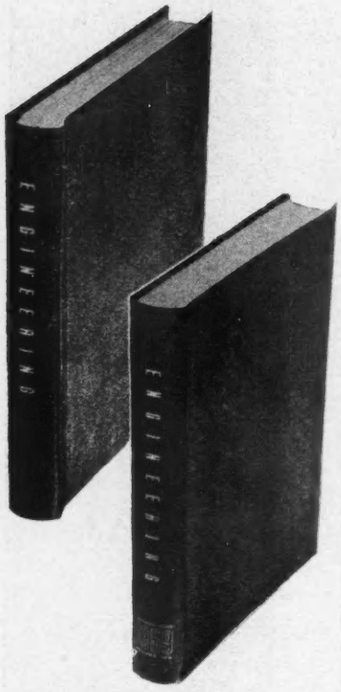
Wedglok eliminates
all auxiliary
locking devices;
it simplifies design;
it cuts assembly time;
it stays put.

GKN WEDGLOK

GKN WEDGLOK
products include WEDGLOK
Screws and Bolts and
WEDGLOK Nuts in a wide
variety of sizes.

Guest Keen & Nettlefolds (Midlands) Ltd., Screw Division, Box 24, Heath Street, Birmingham 18.
Telephone: Smethwick 1441. Telex 33-239

s/wx/3817



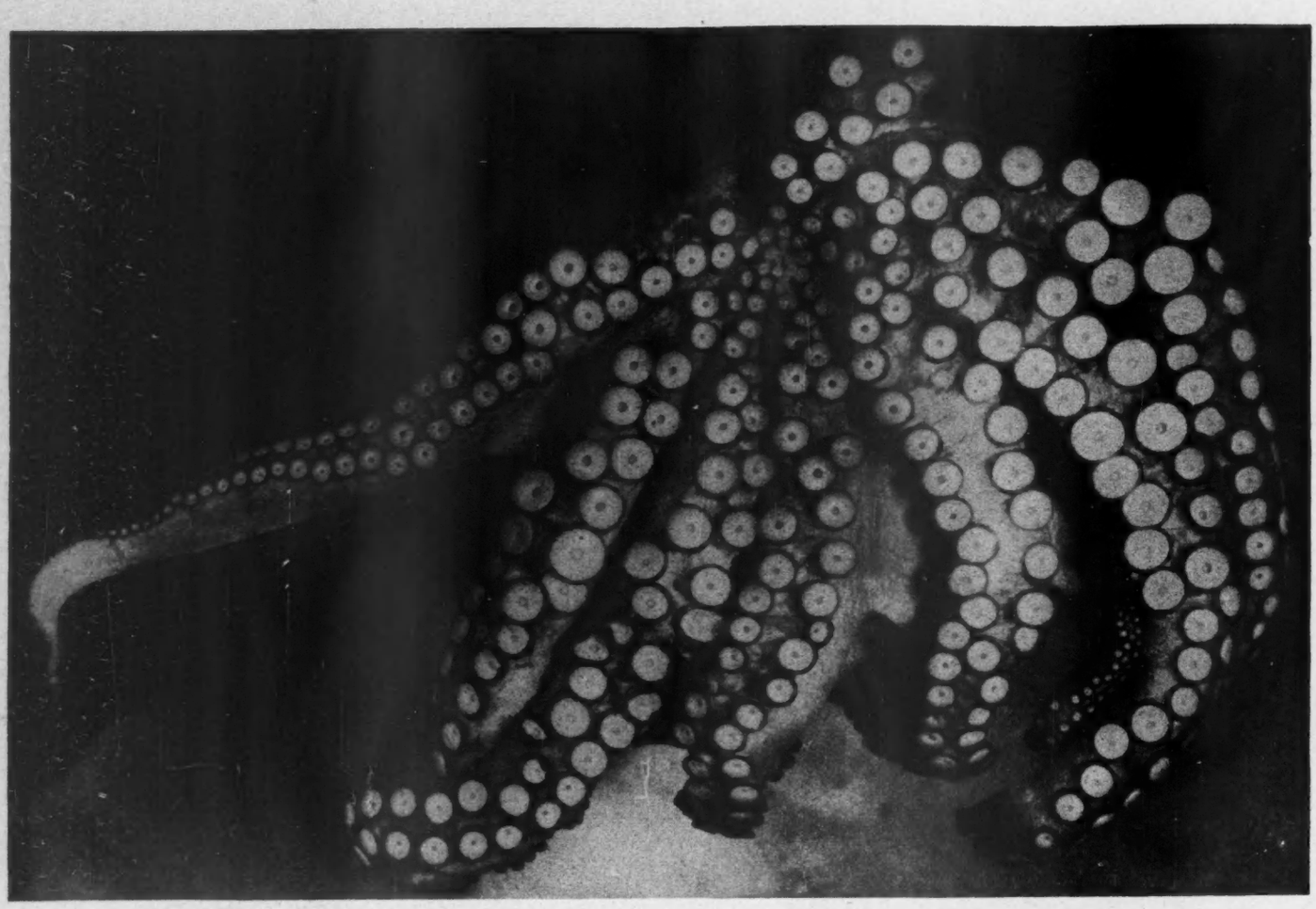
'QUICKBINDE' AND PERMANENT-BINDING CASES

Left: the improved "Quickbinde", finished in dark green with washable covers. Lettering blocked in silver. Takes one volume of "Engineering" editorial pages or six issues complete with advertisements. Pages secured by three spring clips. Price 18s. 6d. post paid. Pair of levers (for first binder only) 9d. extra.

Right: the permanent-binding case for a volume of editorial pages. Finished dark green in washable durable material; lettering, volume number and months, and year blocked in silver. Prices: one case 17s. 6d. post paid; supplying one case and binding your pages 52s. 6d. post paid. When ordering, please specify volume number and dates.

Orders and remittances to 'Engineering' 36 Bedford Street, London, W.C.2. (telephone: TEMple Bar 3663)

"Do T.V. Belts help a whiter wash Dad?"
TURNERS
Somehow, our little friend has discovered that washing machines rely on T.V. Belts (Turners V-Belts) for power transmission. You will find T.V. Belts in many well-known household appliances from refrigerators to washing machines —products continually in the limelight. Let T.V. Belts help to put your products in the picture too!
TURNERS V-BELTS*
*Rayon or "Terylene" Corded
Reg.
THE MARK OF BETTER BELTING
The Servis Supertwin, combining "deep-cleanse" washing and "soak-rinse" spin-drying uses T.V. Belts.
TURNER BROTHERS ASBESTOS CO LTD ROCHDALE ENGLAND
A MEMBER OF THE TURNER & NEWALL ORGANISATION
TA.21



Man-made Octopus

Octopus-like, this KING installation at the Banbury Works of the Northern Aluminium Co. Ltd., manufactured in collaboration with Millars' Machinery Co., Ltd., Vacuum Division, Bishops Stortford, handles aluminium slabs 90 ft. long, 7 ft. wide, ½ inch thick; octopus-like—by tentacles and suction. 44 suction pads are suspended from the lifting beam manifold, each having an automatic cut-off device to prevent loss of vacuum when shorter slabs are required to be lifted. All this is remotely controlled by one operator—yet another example of the superb ingenuity and efficiency of the KING approach.

If you have a problem that needs careful handling—call in KINGS's—and remember, KING's representatives will call on you anywhere in the world.

GEO. W. KING LIMITED

CONVEYORS, HOISTS, CRANES & GRABS

ARGYLE WORKS 4/E · STEVENAGE · HERTFORDSHIRE

Telephone: Stevenage 440 (14 lines)

NO MAINTENANCE FOR 6 YEARS IN THE WETTEST CLIMATE IN ENGLAND

The Alston Foundry Company Limited, of Cumberland, say: ***"The *bridge is perpetually exposed to the elements, the action of which has had absolutely no effect whatever on the installation . . . there have been no appreciable signs of wear and it has never been necessary to carry out any form of maintenance to the bridge walkway in the period under review."***

ALAFLOR

*They were referring to a bridge which, since its installation, has carried tens of thousands of people, in heavy industrial footwear, in the worst weather in England. An ALAFLOR installation, of course! The illustration shows the ALAFLOR bridge after 6 years.

EXTRUDED ALUMINIUM FLOORING AND TREADS

ARCHIBALD LOW & SONS LIMITED

KIRKINTILLOCH SCOTLAND • HOME & OVERSEAS SALES OFFICE 143 SLOANE STREET LONDON S.W.1. TEL: SLOane 6178 756

WM FLOWLINE VALVES

FLOW CONTROL PINCH VALVES

A new range of pinch valves for automatic or remote operation designed for use in conjunction with standard or special control gear. This valve combines the naturally good flow characteristics of a Pinch valve with good response characteristics when used in conjunction with standard instruments; whilst not quite linear the response is markedly superior to other designs of pinch or diaphragm valves. If you prefer electric operation we can provide it.

WARREN-MORRISON LTD

41 St. James's Place, London, S.W.1.
MAYfair 9895

NITRIDED Nitralloy STEELS

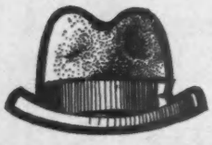
The Nitriding Process for Case-Hardening Special Steels by Nitrogen Offers

- Surface hardness up to 1100 D.P.H.
- Improved resistance to corrosion by water and steam.
- Retention of full hardness after heating to 500 °C.
- Maximum resistance to frictional wear and fatigue.

Particulars from :—

NITRALLOY LIMITED · ATLAS WORKS · SHEFFIELD, 4.

Telephone: Sheffield 26646. *Telegrams: "Nitralloy, Sheffield."*

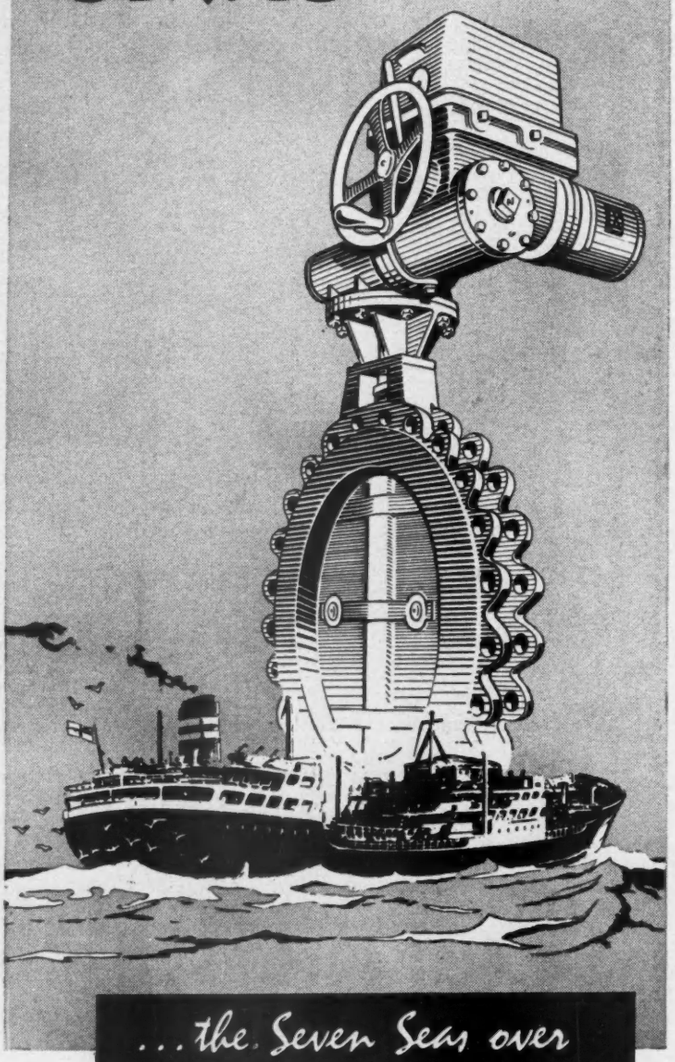


Looking in the right direction

Ratcliffe SPRINGS

F. S. RATCLIFFE (ROCHDALE) **LTD.,**
Crawford Spring Works, Norman Road, Rochdal
Phone: Rochdale 40415 'Grams: Recoil, Rochdale
Telex No: 63178 P.W. 5968/1

LIMITORQUE SERVES



...the Seven Seas over

LIMITORQUE is a product of precision engineering backed by a hundred years of manufacturing experience. This highly sensitive automatic mechanism — powered electrically, pneumatically or hydraulically — is adaptable to all types of valves, including existing manually operated units. ***LIMITORQUE*** controls valves, water-tight doors, sluice gates, and is designed to operate "ON / OFF" and "CONTROL" valves. Incorporated in the patented design is a "hammer-blow" device for unseating sticky valves, a highly sensitive torque switch for controlling torque and thrust loads, rotor type geared limit switches that can be preset to customers own valve travel requirements and an isolated handwheel for emergency use. Where installations are widely separated the ***LIMITORQUE*** Remote Control system provides for quick action without endangering personnel Detailed literature is available.

* *Illustration shows a* ***LIMITORQUE*** *type SMAO-NH1B operating a 24" Cockburn (Rockwell) Butterfly Valve*

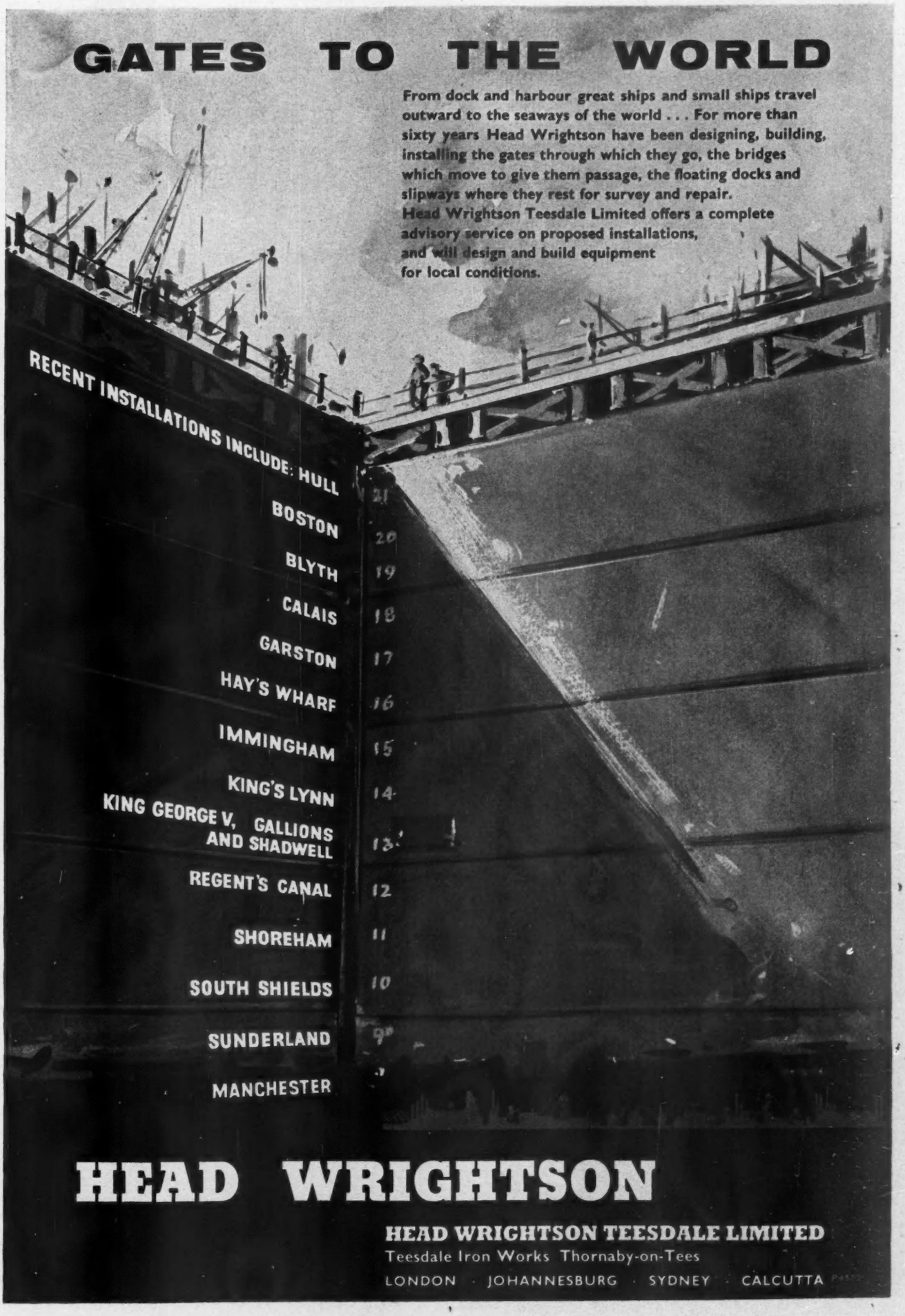
LIMITORQUE VALVE CONTROLS LTD.

Newbury, Berkshire. Telephone: Newbury 1701. Grams: LimiTorque Newbury

An associated company of Opperman Gears Limited

GATES TO THE WORLD

From dock and harbour great ships and small ships travel outward to the seaways of the world . . . For more than sixty years Head Wrightson have been designing, building, installing the gates through which they go, the bridges which move to give them passage, the floating docks and slipways where they rest for survey and repair.
Head Wrightson Teesdale Limited offers a complete advisory service on proposed installations, and will design and build equipment for local conditions.

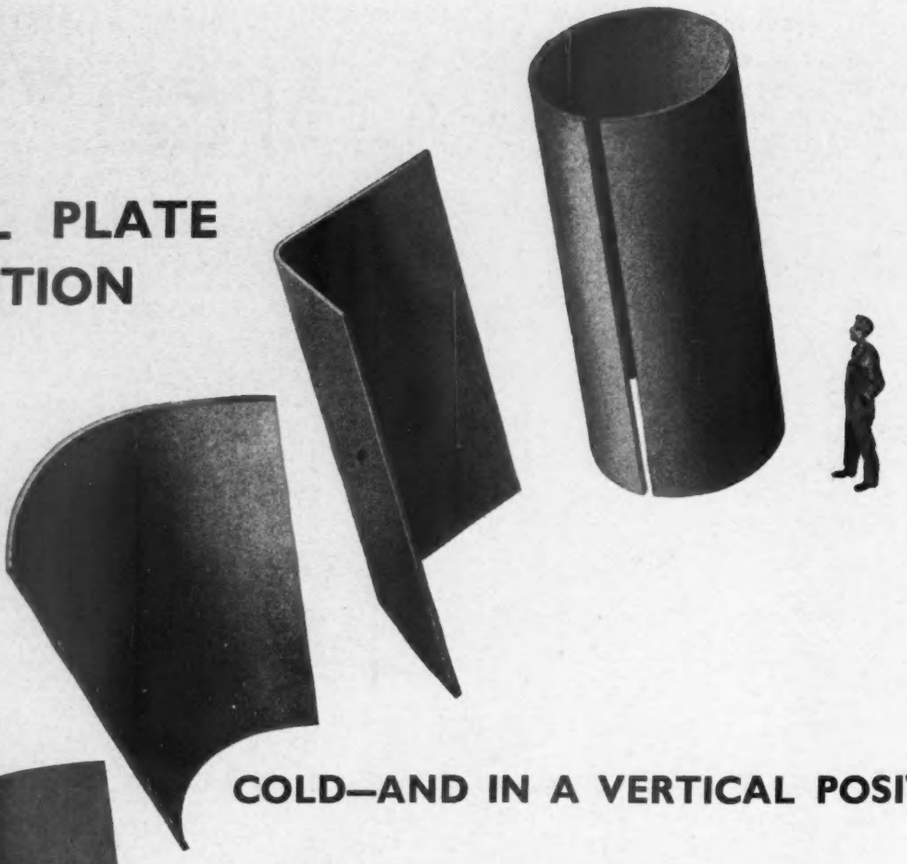


RECENT INSTALLATIONS INCLUDE:
HULL
BOSTON
BLYTH
CALAIS
GARSTON
HAY'S WHARF
IMMINGHAM
KING'S LYNN
KING GEORGE V, GALLIONS AND SHADWELL
REGENT'S CANAL
SHOREHAM
SOUTH SHIELDS
SUNDERLAND
MANCHESTER

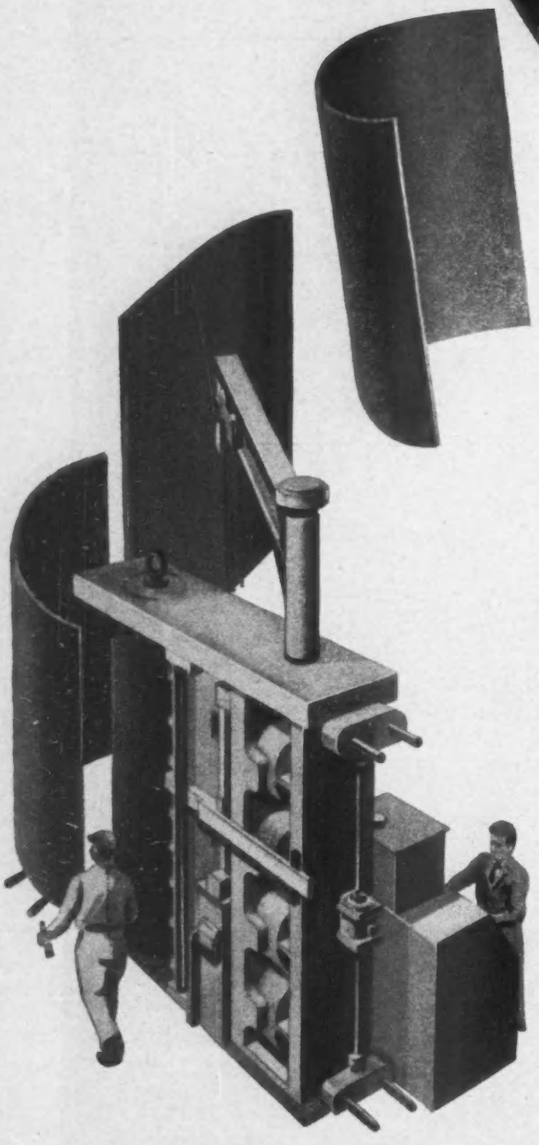
HEAD WRIGHTSON

HEAD WRIGHTSON TEESDALE LIMITED
Teesdale Iron Works Thornaby-on-Tees
LONDON · JOHANNESBURG · SYDNEY · CALCUTTA

HEAVY STEEL PLATE MANIPULATION



COLD—AND IN A VERTICAL POSITION



HUGH SMITH

Direct-acting Plate Bending Presses

offer distinct advantages in cost, convenience in operation, speed and efficiency.

BENDS PLATES UP TO 3" THICK

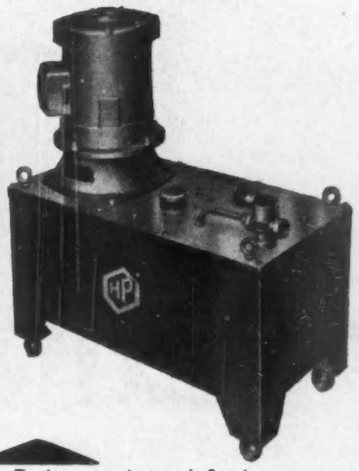
This machine is of relatively low capital cost but has a performance much superior to conventional types of plate bending rolls, and is also dual purpose in that it will both bend and flange even the heaviest plates used in boilermaking and general fabrication. The powerful direct-acting rams can be brought to bear close to the plate edge, which eliminates pre-setting.

We will be pleased to provide technical information and performance figures.

HUGH SMITH & CO. (POSSIL) LTD.,
Hamiltonhill Road, Glasgow, N.2.
POSSIL 8201-2-3 "POSSIL, GLASGOW"

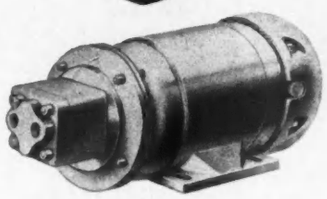
A RANGE OF SELF CONTAINED

HYDRAULIC POWER UNITS
FOR ALL APPLICATIONS



Tank unit designed for larger pump capacities up to 8.5 g.p.m.

Hydraulic gear type pump, close coupled to 1 H.P. Motor



Tank unit incorporating 1.5 g.p.m. Radial Piston Pump type A.V.D. 29, direct coupled to 2½ H.P. Motor.

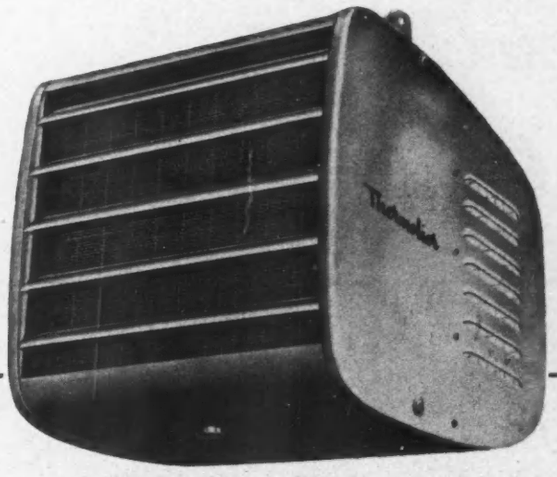
These highly efficient and dependable H.P. Hydraulic Power Units have a wide range of industrial applications. Electric motors are supplied for 400/440 volt 50 cycle 3 phase to B.S.S. 2613, or to customer's requirements.

★ Write NOW for fully illustrated literature.

HYDRAULICS & PNEUMATICS LIMITED, WULFRUNA WORKS, VILLIERS STREET, WOLVERHAMPTON.

The NEW THERMOLIER unit heater

Registered Design No. 888398



The New Thermolier Unit Heater, employing steam or accelerated hot water, provides heat exactly where and when it is required.

Warm air directed to working level maintains a comfortable temperature and constant circulation prevents stagnation.

Thermolier Unit Heaters can be installed without sacrifice of floor space and without extensive structural alterations.

★ IMPROVED PERFORMANCE

★ MODERN DESIGN

Mather & Platt LIMITED

PARK WORKS, MANCHESTER, 10

Telephone: COLlyhurst 2321 Telegrams: Sprinkler, Manchester

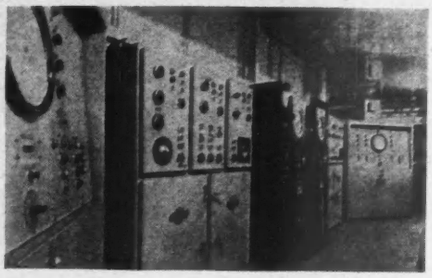
A81/1

Clean Handling

. . . a relatively new concept in many industries, where dirty or dusty working conditions were for long accepted as inevitable because of the dirtiness or dustiness of the materials which have to be handled.

A concept made possible by the development and extension of handling techniques, particularly in pneumatic handling, to which Simon Handling Engineers Ltd., have contributed so much. Techniques which allow clean handling of grain, coal, chemical powders and other materials, resulting in reduced costs as well as better working conditions.

CLEAN HANDLING of grain, coal, alumina, phosphates and other granular materials discharged pneumatically from ships' holds. When suction nozzles like these are at work there is no sign of the disagreeable and sometimes injurious dust raised by mechanical unloading plant.

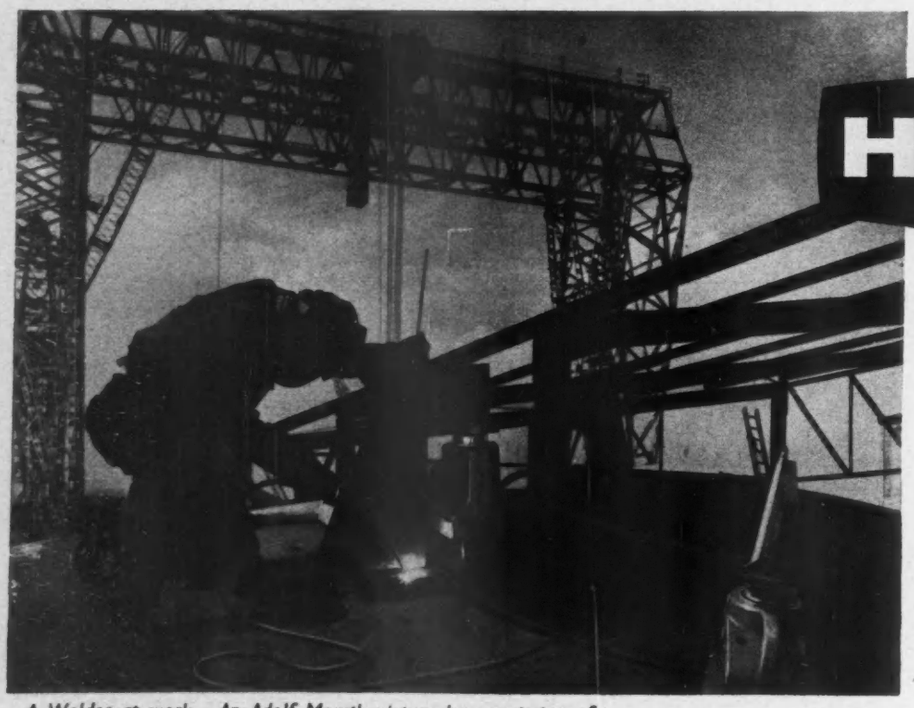


CLEAN HANDLING of carbon blacks at the India Tyre and Rubber Company's factory at Inchinnan, Scotland. From a bulk intake point the blacks are conveyed to storage hoppers and thence through a weigher hopper direct to the Banbury mixers, by a mechanical handling system operated from control panels

FOR CLEAN HANDLING, ACCURATE HANDLING AND FAST HANDLING SEE

Simon Handling Engineers Ltd

STOCKPORT, ENGLAND Telephone: GATLEY 3621 Telex 66-287 Telegrams: S.H.E.L. Telex STOCKPORT



A Welder at work. An Adolf Morath picture by permission of Bradwell Nuclear Power Station and The Nuclear Power Group.

Hydralite

SO LIGHT AND HANDY

Normally one would not expect to see a 50 tons capacity Jack used for such 'light' work (a few tons pressure only being needed). Hydralite Jacks, however, are so light and easy to handle (not to mention their ease of operation), that they are preferred to the lower capacity conventional tools. Hydralites are available in a range from 15 to 100 tons. THERE ARE A THOUSAND AND ONE JOBS FOR HYDRALITES.

YOU SHOULD HAVE CATALOGUES AT HAND — SEND TODAY

Ad. No. 90

TANGYES LIMITED

SMETHWICK · BIRMINGHAM · Phone: SME 1181

BECAUSE NOTHING ELSE WILL DO

Sooner or later you'll meet up with it—perhaps you have already—the connection that only Plessiflex can make!
The moment of recognition is instantaneous. It comes when you are faced with apparently insurmountable problems of vibration, misalignment, corrosion, and extremes of temperature or pressure. Should you not already be fully acquainted with the outstanding characteristics of Plessiflex, you will find Publication No. 1121 to be very enlightening.

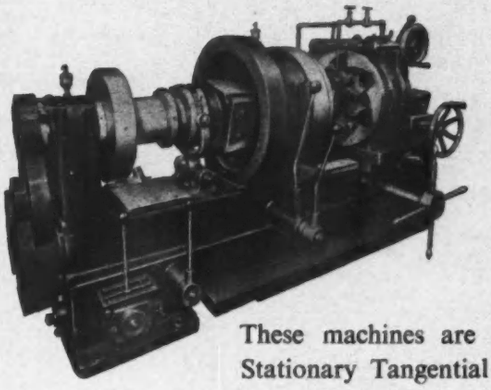
POWER AUXILIARIES LTD
Kembrey Street
Swindon · Wilts
Tel: Swindon 6211

Overseas Sales Organisation:
Plessey International Limited, Ilford, Essex
Telephone: Ilford 3040

PAL 15A

HEAP'S Rapid Grip

THREADING AND CUTTING MACHINES

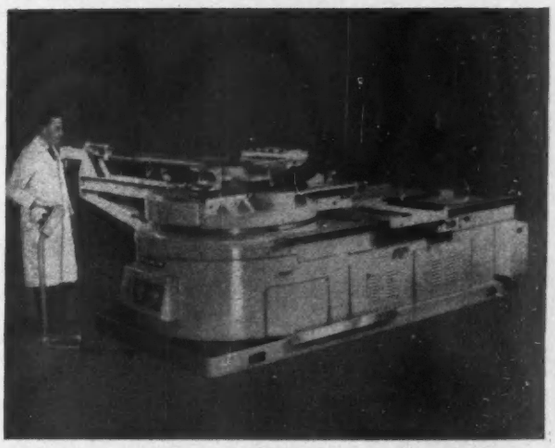


These machines are fitted with our Stationary Tangential Die heads and have been designed for production screwing of all sizes of pipes up to 12". They are in use wherever large quantities of piping have to be screwed, e.g. in Tube Works or in the Petroleum Industry. This type of machine can be supplied with 2-in., 4-in., 6-in., 8-in. and 12-in. capacity dieheads.

JOSHUA HEAP & CO., LTD.
ASHTON-UNDER-LYNE · ENGLAND

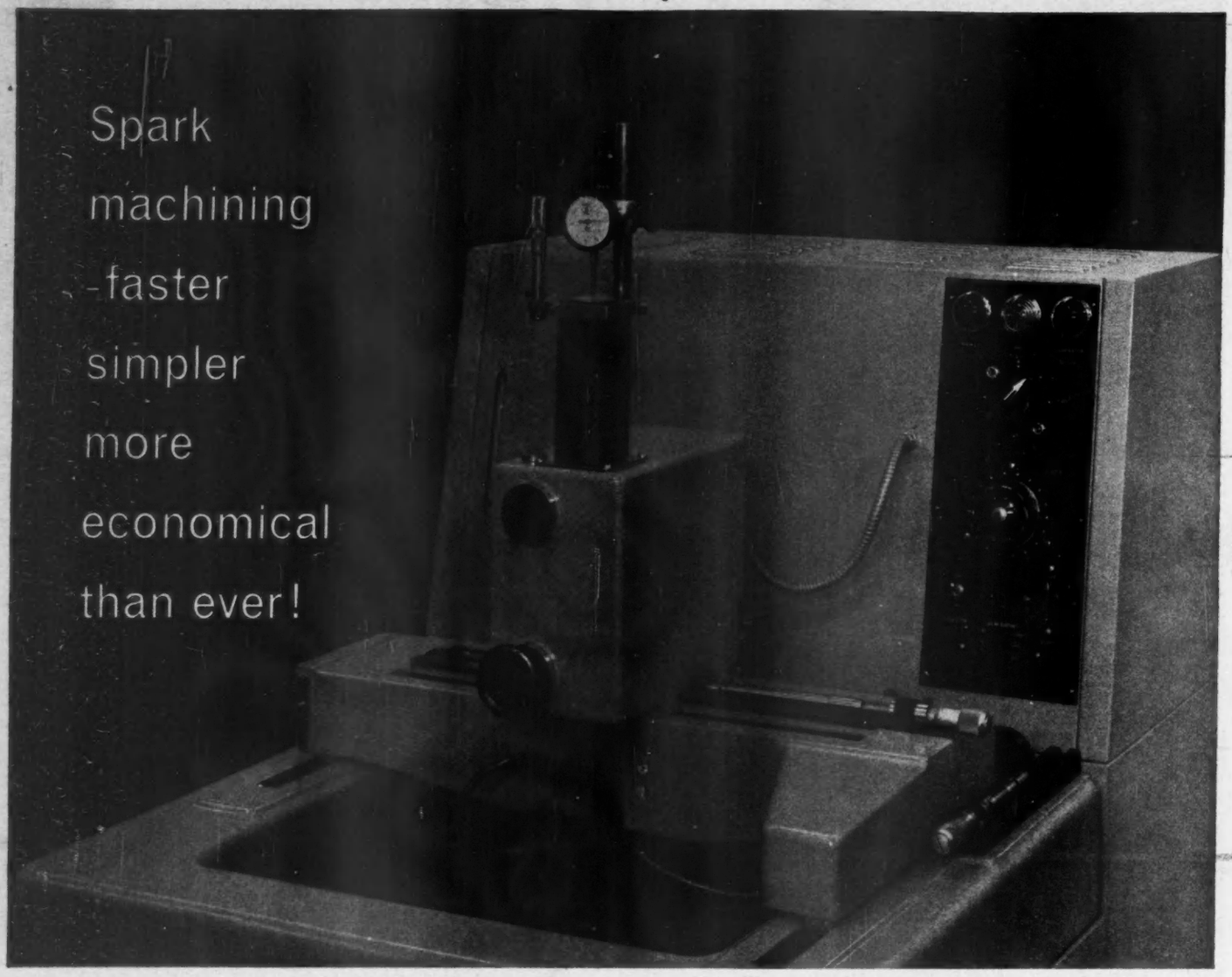
HILMOR
TUBE BENDING MACHINERY

★ Heavy duty motorised Mandrel Bender, Type MSA6, with robust all mechanical drive.
★ Produces full bore bends, free from wrinkling, cold and unfilled on standard or short radii.



★ Easily set up for both left-hand and right-hand bending.
★ Variable speed gear-box provides correct bending speed according to size and class of tube.
★ Bends up to 6¼in. dia. mild and stainless steel tube, 6in. bore gas, steam and hydraulic tube and 8¼in. dia. non-ferrous tube.

HILMOR LTD. (Sales and Service)
CAXTON WAY, STEVENAGE, HERTS.



The GKN Spark Machine is faster, more accurate, more versatile

The GKN Spark Machine (Models B1 and B2) gives higher cutting rates, greater accuracy, and—on the B2 machine—a wider range of surface finishes than ever before.

It has all these outstanding features

These are some of the outstanding features of the GKN Spark Machine Models B1 and B2 :—

A co-ordinate slide movement for rapid electrode positioning; an accurate depth stop ; a dial gauge to show forward movement ; an alternative work-table for extra paraffin depth.

It is compact and economical

The GKN Spark Machine is well-made, sturdy and compact. All parts of it—work head, electrical equipment and paraffin system—are mounted in the same cabinet. Yet with all these advantages, installation and running costs are low.

You should know more about it

Whether you are engaged in forging, wire-drawing or press-tool making, the GKN Spark Machine is something you should know about.

Write to our Sales Agents for the new brochure on the GKN Spark Machine.

Manufactured by

WELSH METAL INDUSTRIES LTD., Caerphilly, Glamorganshire

Sales Agents U.K

M. C. Layton Limited, Abbey Wharf Mount Pleasant, Alperton, Wembley, Middx

Rudkin & Riley Limited, Cyprus Road, Aylestone, Leicester

GKN spark machine

DESIGNED BY THE GKN GROUP RESEARCH LABORATORY

Printed by HARRISON & SONS, LTD., by Appointment to H.M. The Queen, Printers, London, England. Published by ENGINEERING LTD., at 36 Bedford Street, London, W.C.2

A QUICK WAY

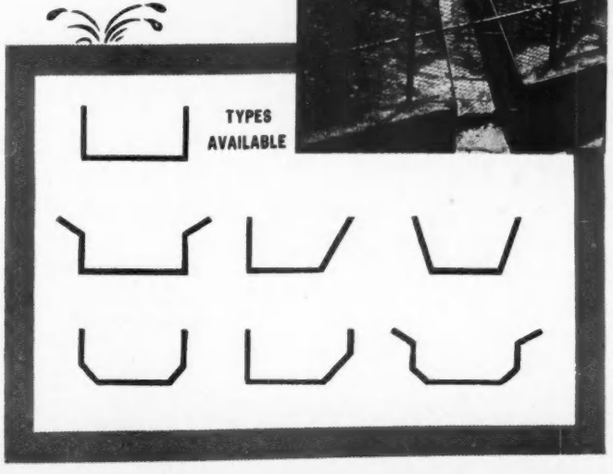
to get rid of water

The problem of draining underground and surface workings may be solved quickly and efficiently by the use of Harvey Pressed Steel Gutters. Available in lengths up to 12 ft., which are simply bolted together, Harvey Gutters enable long runs of continuous channel to be assembled with the minimum of labour.

Stoutly constructed in mild steel plate, in various sections and to any girth, the gutters can be supplied complete with angle pieces, stop ends, outlet units, etc., as required. Please ask for literature.

Water pumped from lower level to main sump through Box Gutters at an Iron Ore Mine in Glamorgan. *Below: Continuation towards outfall.*

460 ft. length Box Gutter leads water to nearest stream, preventing seepage to underground workings.



HARVEY

PRESSED STEEL GUTTERS

G. A. HARVEY & CO. (LONDON) LTD.
Woolwich Road, London, S.E.7. GREenwich 3232 (22 lines)

Other Harvey Products: HIGH CARBON STEEL WIRE SCREENS MACHINERY GUARDS • PERFORATED MILD STEEL CABLE TRAYS PERFORATED SCREEN PLATES • STEEL PLATE & SHEET METALWORK WIREWORK • WOVEN WIRE IN ALL METALS LF/17

Structural Steelwork

We undertake contracts for the design, fabrication and erection of steel structures such as bunkers, hoppers, chimneys and all associated steelwork, especially for chemical and petroleum plants, ore-handling and sintering equipment, blast-furnace and steelworks auxiliary plant and similar industrial works.

The illustrations show steelwork at a chemical works and one of many gantries supporting ducting at a nuclear power station.

JOHN THOMPSON (DUDLEY) LTD · DUDLEY · WORCS

JOHN THOMPSON (DUDLEY) LIMITED — JOHN THOMPSON GROUP

DF/3